Single Aisle
TECHNICAL TRAINING MANUAL
T1+T2 (IAE V2500) (Lvl 2&3)
APU

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APU

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HONEYWELL 131-9(A)

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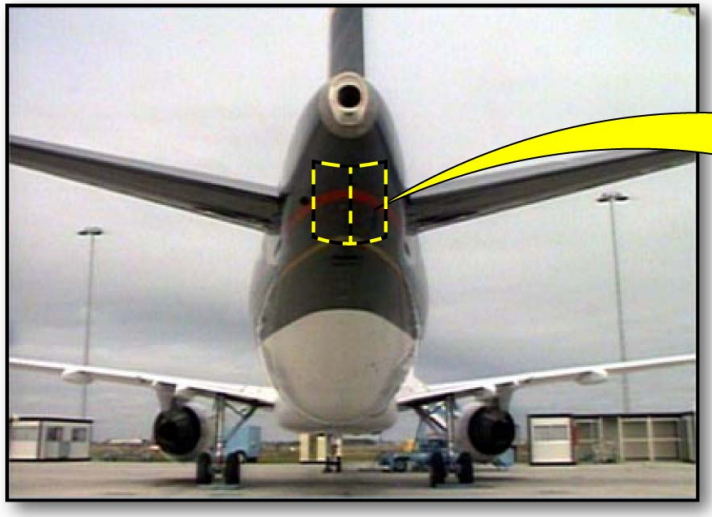
APU SYSTEM COMPONENT LOCATION (2)

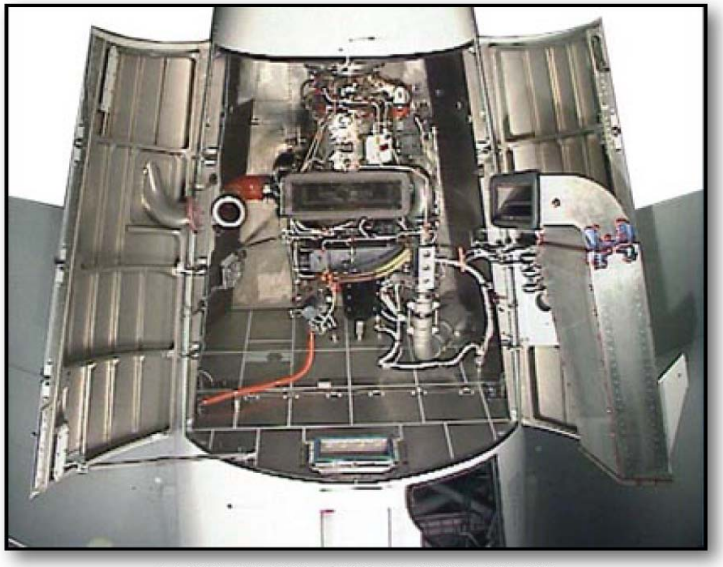
SYSTEM OVERVIEW

The Auxiliary Power Unit (APU) is a constant speed gas turbine engine. It is located in the unpressurized tail cone. The APU is a self-contained unit, which enables the aircraft to be independent of external pneumatic and electrical power sources.
The constant-speed gas turbine engine drives the accessory gearbox and a load compressor. The APU provides:
- electrical power for the aircraft systems,
- bleed air for engine starting (MES), air conditioning (ECS) and wing anti ice testing on ground (not GTCP 36-300),
- bleed air for air conditioning and pressurization in flight until the specified manufacturer limit.

The APU is designed to operate throughout the entire flight envelope. Electrical power is available whenever the APU operates, but bleed air is shut off above the specified manufacturer limit.
The APU has an air intake flap. The intake flap is open when the APU master switch is selected ON and closes when the master switch is selected OFF. When open, it provides air to the APU inlet for combustion and pneumatic supply.



AIRCRAFT TAIL CONE



AUXILIARY POWER UNIT (APU)

SYSTEM OVERVIEW

APU SYSTEM COMPONENT LOCATION (2)

COMPONENT LOCATION

The APU is installed in the tail section of the fuselage.

ENGINE VIEW

The left and right hand sides of the APIC 3200 APU are shown.
The left and right hand sides of the Honeywell 131-9 [A] APU are shown.

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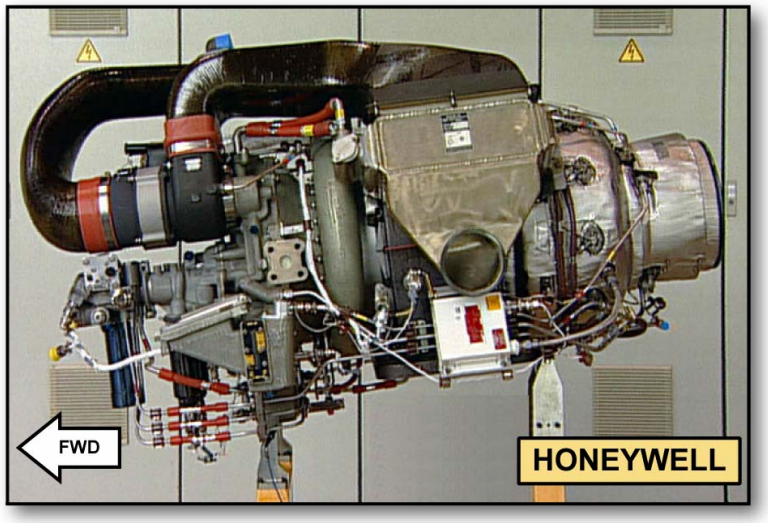

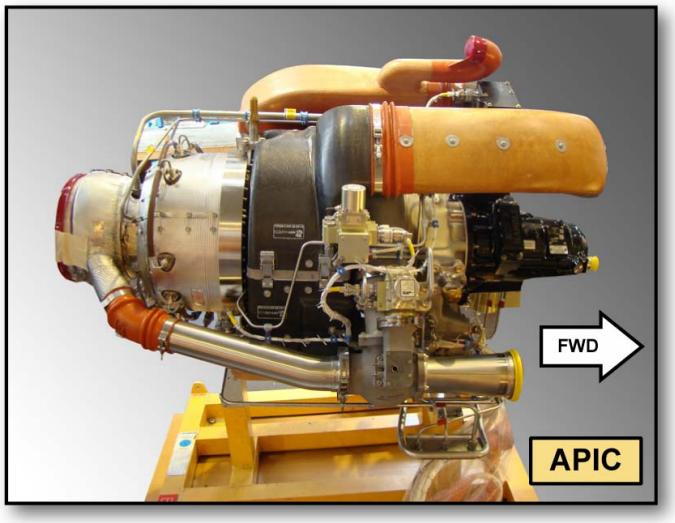

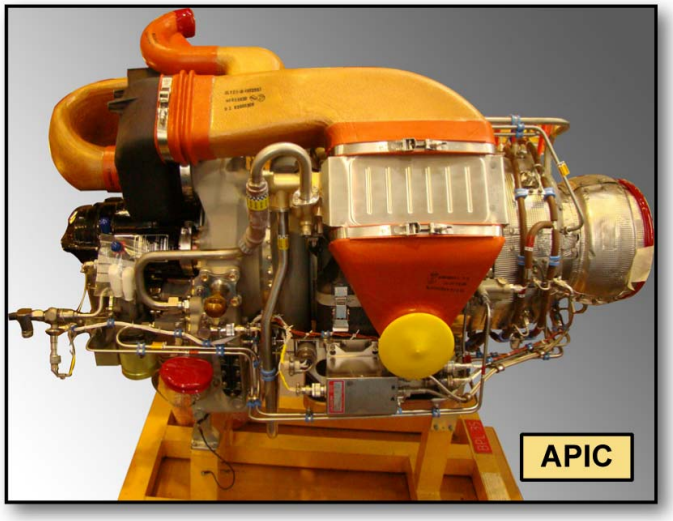

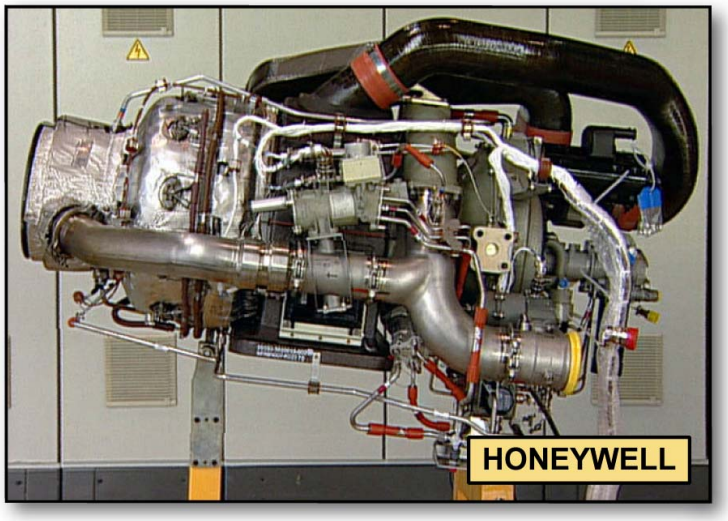

COMPONENT LOCATION - ENGINE VIEW

APU SYSTEM COMPONENT LOCATION (2)

COMPONENT LOCATION (continued)

ELECTRONIC CONTROL BOX (ECB)

The ECB is in the aft cargo compartment, RH side.

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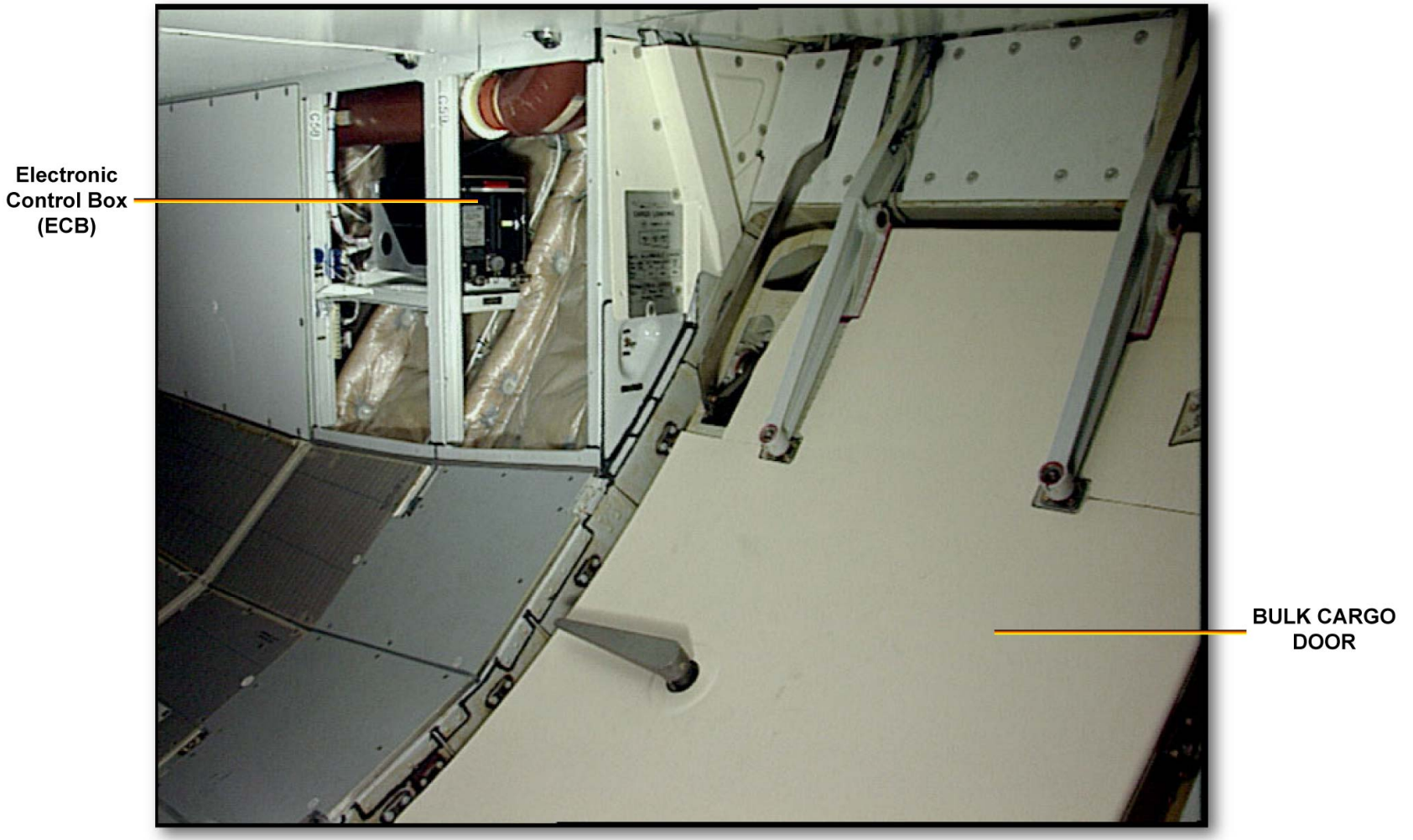

COMPONENT LOCATION - ELECTRONIC CONTROL BOX (ECB)

APU SYSTEM COMPONENT LOCATION (2)

COMPONENT LOCATION (continued)

AIR INTAKE FLAP

The APU has an air intake flap. The air intake flap opens when the APU MASTER SWitch is set to ON and it closes when the MASTER SWitch is set to OFF and the APU stops. When open, it supplies air to the APU inlet for combustion and pneumatic supply.

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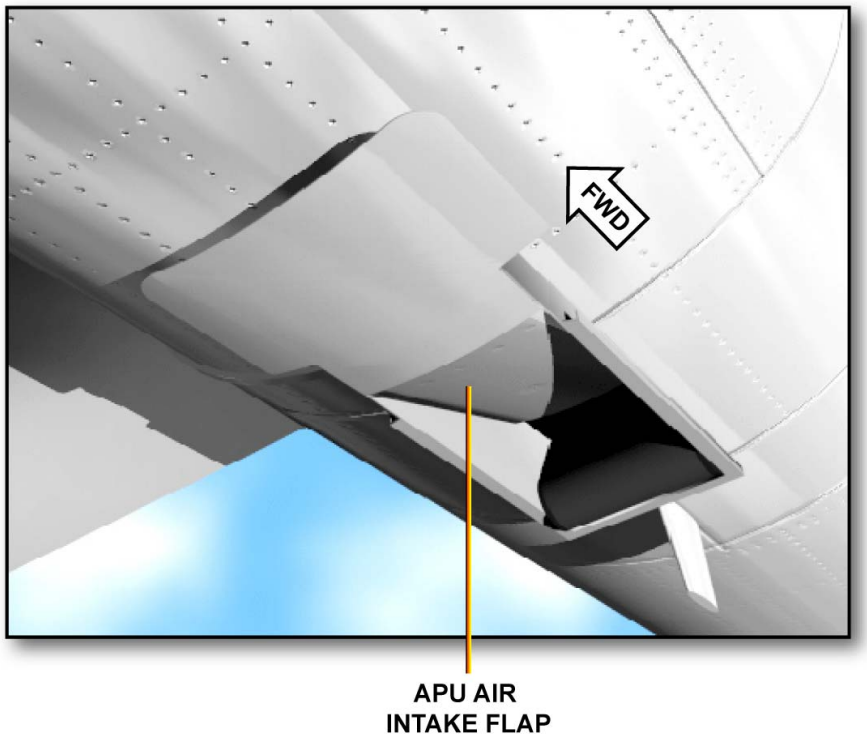

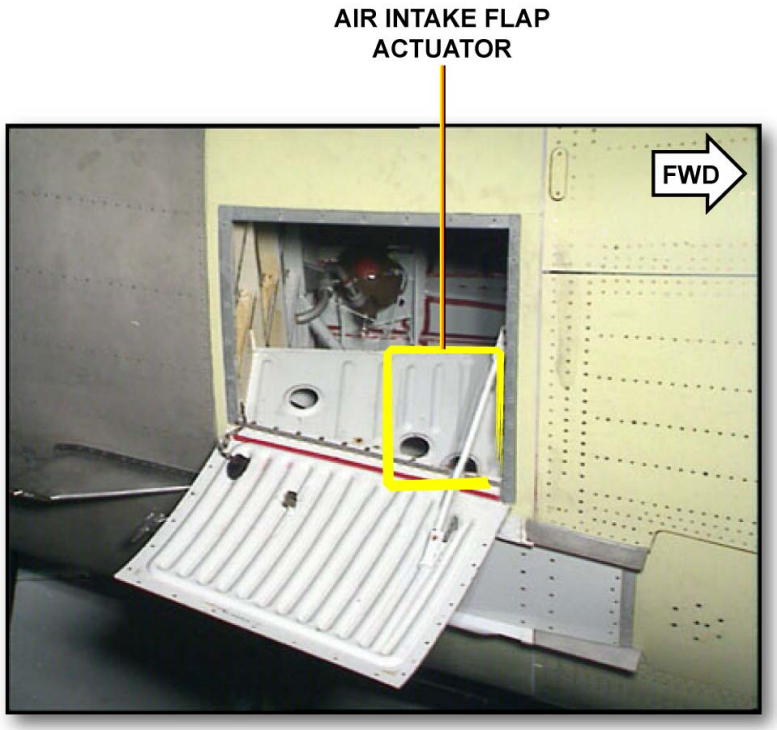

COMPONENT LOCATION - AIR INTAKE FLAP

APU SYSTEM CONTROL & INDICATING (2)

LOCATE CONTROL/INDICATING IN COCKPIT

ECB POWERING / APU AVAILABLE

APU LOW OIL QUANTITY

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APU INSTALLATION PRESENTATION (2)

GENERAL

The Auxiliary Power Unit (APU) is installed in a fireproof COMPartment (COMPT) located in the fuselage tail cone.

MOUNTS

Seven tie rods attach the APU to the structure brackets on the APU COMPT ceiling. These tie rods also connect to the APU three-point mounted suspension system. Vibration isolators are installed between the APU mount brackets and the tie rods to reduce the transmission of A/C vibrations and shocks to the APU. The isolators also prevent the transmission of vibrations from the APU to the A/C structure.

AIR INTAKE FLAP

The air intake system ducts ambient air to the APU plenum chamber. An air intake flap cuts off the air supply when the APU does not operate. In case of failure, the air intake flap can be opened or closed manually by a manual override device.

AIR INTAKE DUCT

The air intake duct, which is composed of a diffuser and elbow, provides correct airflow to the APU plenum. The air intake duct is attached to the right access door.

EXHAUST

The exhaust system lets the APU exhaust gas flow into the atmosphere and muffles the noise from the exhaust. The exhaust muffler thermal insulation protects the A/C structure.

ACCESS DOORS

Two access doors allow access to the APU COMPT. The access doors on the bottom of the tail cone open outwards to allow the APU to be inspected, lifted and lowered.

DRAIN SYSTEM

A drain system prevents the collection of fluids in the APU COMPT. Any fluid that may accumulate in the APU COMPT is delivered to a drain mast. Some of the fluids are collected in a drain tank in the APU COMPT, which is emptied through the drain mast when the A/C is above 200 kt.

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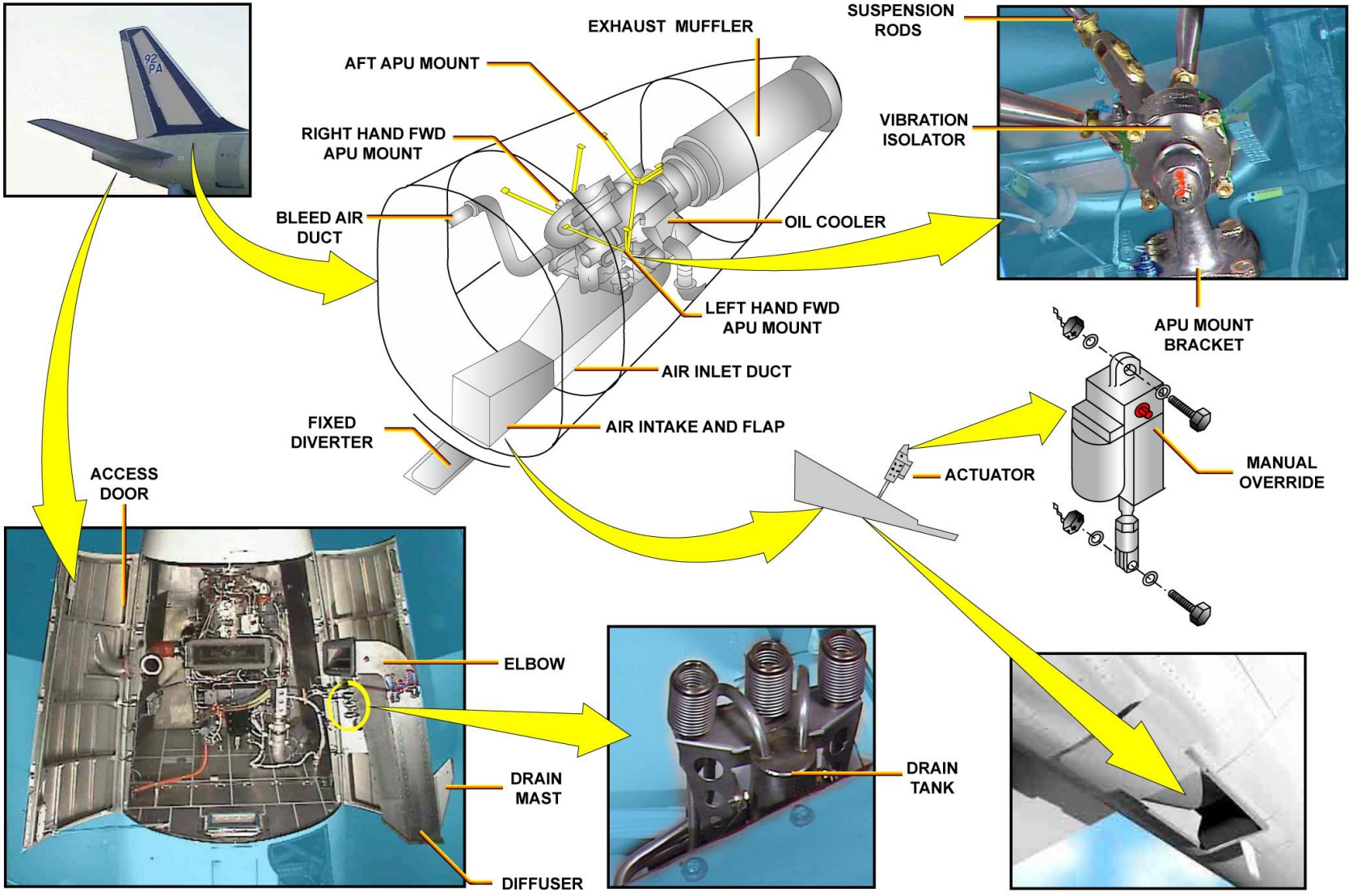

GENERAL ... DRAIN SYSTEM

APU DRAIN SYSTEM PRESENTATION (2)

Apu Drain System

A drain system prevents the collection of fluids in the Auxiliary Power Unit (APU) system and compartment.

FUEL CONTROL UNIT/OIL PUMP SEAL DRAIN

The fuel and oil pump seal drain line is routed via a collector line to the drain tank. This line drains fuel or oil leaks.

INLET GUIDE VANE ACTUATOR DRAIN

The Inlet Guide Vane (IGV) actuator drain line is routed via the collector line to the drain tank. This line drains only fuel leaks.

GEARBOX VENT

The oil reservoir has a connection to the ambient air through an air/oil separator. The gear driven air/oil separator is connected through a gearbox vent line to the APU exhaust cone.

SURGE CONTROL VALVE DRAIN

The surge control valve fuel is drained into the drain tank by the Fuel Control Unit (FCU)/IGV actuator common drain line.

LOAD COMPRESSOR CAVITY DRAIN

To prevent any ingestion of oil in the bleed system the load compressor bearing cavities are kept dry by buffering air into the main shaft seals. An oil leak witness drain is located aft of the seal to collect any oil leakage. The oil is drained directly overboard through the drain mast.

TURBINE PLENUM DRAIN

A turbine plenum drain orifice is provided to drain fuel that may accumulate in the combustor following an unsuccessful light-up. The fuel is drained directly overboard through the drain mast.

EXHAUST MUFFLER DRAIN

The exhaust muffler drain line is routed to the drain mast. This drain line collects water or cleaning fluid.

APU COMPARTMENT DRAIN

Water coming from rain or condensate humidity, cleaning agents and any oil and fuel in the compartment, due to leaks or APU servicing, are drained to the lowest point of the APU door and through the drain mast overboard.

DRAIN TANK

For venting and evacuation, the drain tank is connected to the drain mast. Airflow across the drain mast creates a vacuum in the drain line. The suction effect produced at 200 kts, is sufficient to remove the contents of the drain tank. A vent line ventilates the drain tank and drain lines. The APU drain lines are connected to the right access door drain lines through spring adapter kiss seals.

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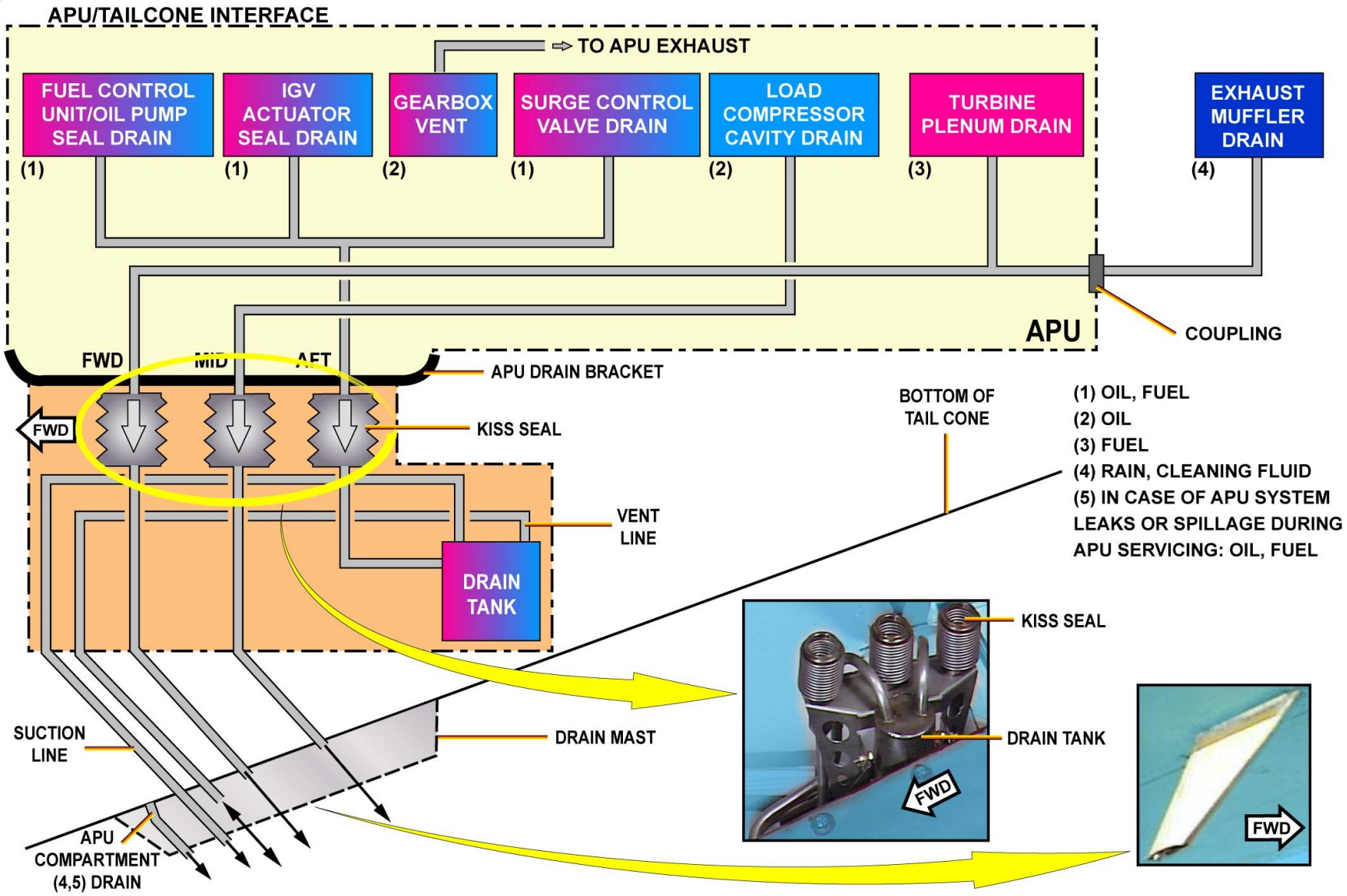

APU DRAIN SYSTEM ... DRAIN TANK

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APU BASIC DESCRIPTION (3)

GENERAL

The Auxiliary Power Unit (APU) is of a modular design. The three APU modules are:
- the power section,
- the load compressor,
- the accessory drive gearbox.

ENGINE COMPRESSOR

The compressor is of a single stage centrifugal compressor design. The main components of the compressor are:
- a single stage centrifugal impeller,
- single stage diffuser vanes,
- axial de-swirl vanes.

COMBUSTION CHAMBER

The combustion chamber is of a reverse flow annular design and is installed inside the turbine plenum. The main parts of the combustion chamber are:
- the inner combustion chamber shell,
- the outer combustion chamber shell.

The following components are installed on the combustion chamber:
- an igniter plug,
- 10 dual orifice fuel nozzles.

TURBINE

The turbine assembly drives the engine compressor, the load compressor and the gear train of the Accessory Gearbox (AGB). The two-stage axial flow turbine includes:
- a cooled first stage nozzle,
- inserted first stage rotor blades,
- an un cooled second stage stator,
- a dual alloy second stage rotor,
- an annular exhaust diffuser.

LOAD COMPRESSOR

The load compressor is of a single-stage centrifugal design. It supplies bleed air to the pneumatic system. The primary components of the load compressor are:
- the inlet guide vane assembly,
- the load compressor impeller,
- the load compressor diffuser,
- the load compressor scroll.

The shaft is held with two bearings: one duplex ball bearing in front of the load compressor impellor and one roller bearing aft of the second-stage turbine. As an option, the duplex ball bearing is made of ceramic to make the bearing more resistant to damage caused by debris that go into the bearing compartment.

INLET GUIDE VANES

The Inlet Guide Vanes (IGVs) control the amount of bleed air flow and pressure from the APU load compressor. The 16 IGVs are moved simultaneously by a gear train operated by an actuator. The IGV actuator is operated by high-pressure fuel supplied from the Fuel Control Unit (FCU). The IGV opening angle depends on the bleed air demand for:
- Main Engine Start (MES) system,
- Environmental Control System (ECS).

ACCESSORY GEARBOX

The gearbox transmits the shaft power to the APU accessories and to the APU generator, which are installed on the gearbox pads. The gearbox is also the oil reservoir for the APU lubrication system. The components mounted on the accessory gearbox are:
- the starter motor assembly,

- the cooling air fan assembly,
- the lubrication unit with the oil pump assembly which drives the FCU,
- the AC generator.

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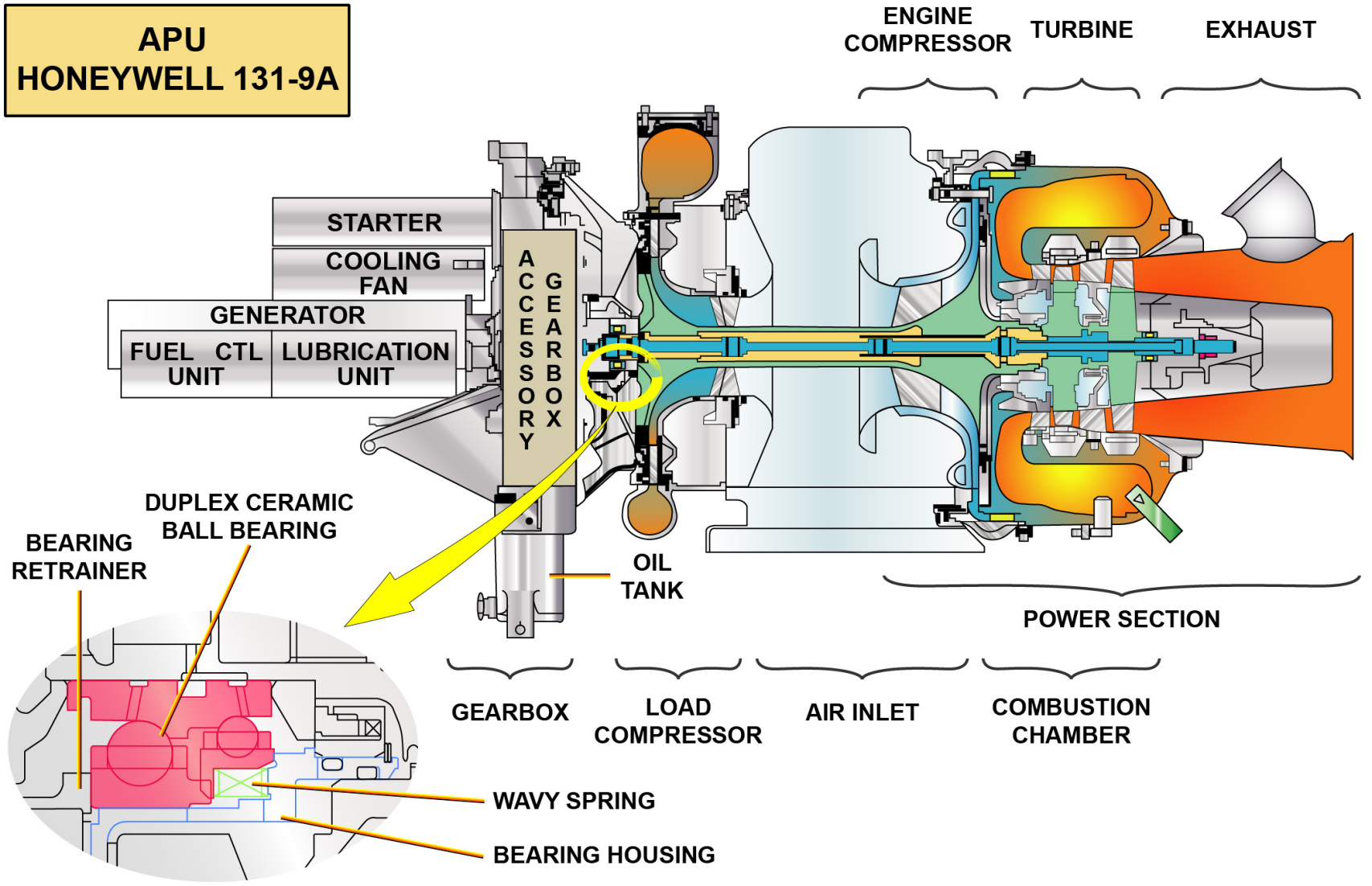

GENERAL ... ACCESSORY GEARBOX

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APU IGNITION & STARTING D/O (3)

STARTER CONTROL

During starting, the electrical starter causes initial rotation of the Auxiliary Power Unit (APU) shaft when it drives the Accessory Gearbox (AGB). When the APU speed is around 50%, the Electronic Control Box (ECB) stops the electrical supply to the starter by opening the main start contactor.
The main start contactor 5KA and the backup start contactor 10KA are heavy duty contactors that switch electrical current to the starter motor. During Ram Air Turbine (RAT) extension, APU starting is inhibited by the Battery Charge Limiters (BCL 1 and BCL 2), which prevent operation of the main start contactor 5 KA by removing the necessary ground signal, to operate the Main Start Contactor, from the MASTER SW.

IGNITION CONTROL

The ignition system causes initial light-off of the fuel air mixture. The ignition system includes an ignition box that energizes an igniter plug. During starting, the ECB switches the ignition to ON between 0% and 60%. When the APU speed drops below 95% due to a flame-out, the ECB starts the ignition until the APU reaches again 100% of speed.

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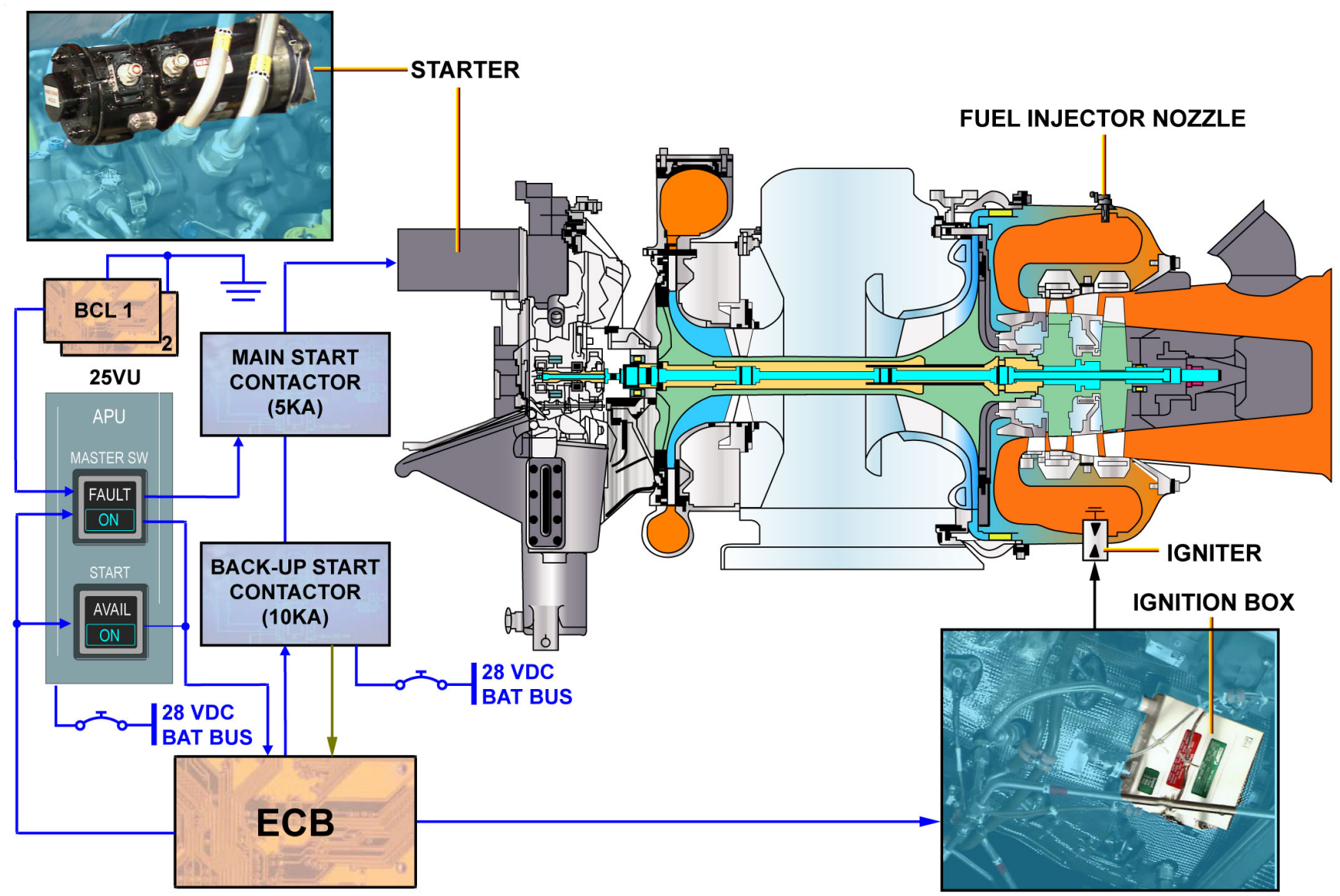

STARTER CONTROL & IGNITION CONTROL

APU FUEL SYSTEM D/O (3)

GENERAL

The fuel system supplies metered fuel to sustain combustion. Part of the fuel, as muscle pressure, operates the Inlet Guide Vane (IGV) actuator and the surge control valve actuator. This system is made of:
- Fuel Control Unit (FCU),
- fuel schedule,
- muscle pressure,
- fuel shut-off,
- flow divider and solenoid valve,
- fuel supply,
- fuel drain,
- control,
- monitoring.

CONTROL

The ECB controls the fuel system with several parameters. During on-speed operation, the ECB uses APU speed, Exhaust Gas Temperature (EGT) and aircraft demand signals. During start, it uses speed, EGT, air inlet pressure and temperature sensors (P2 and T2). The ECB operates the fuel metering valve, the flow divider solenoid valve and the 3-way shut-off solenoid valve.

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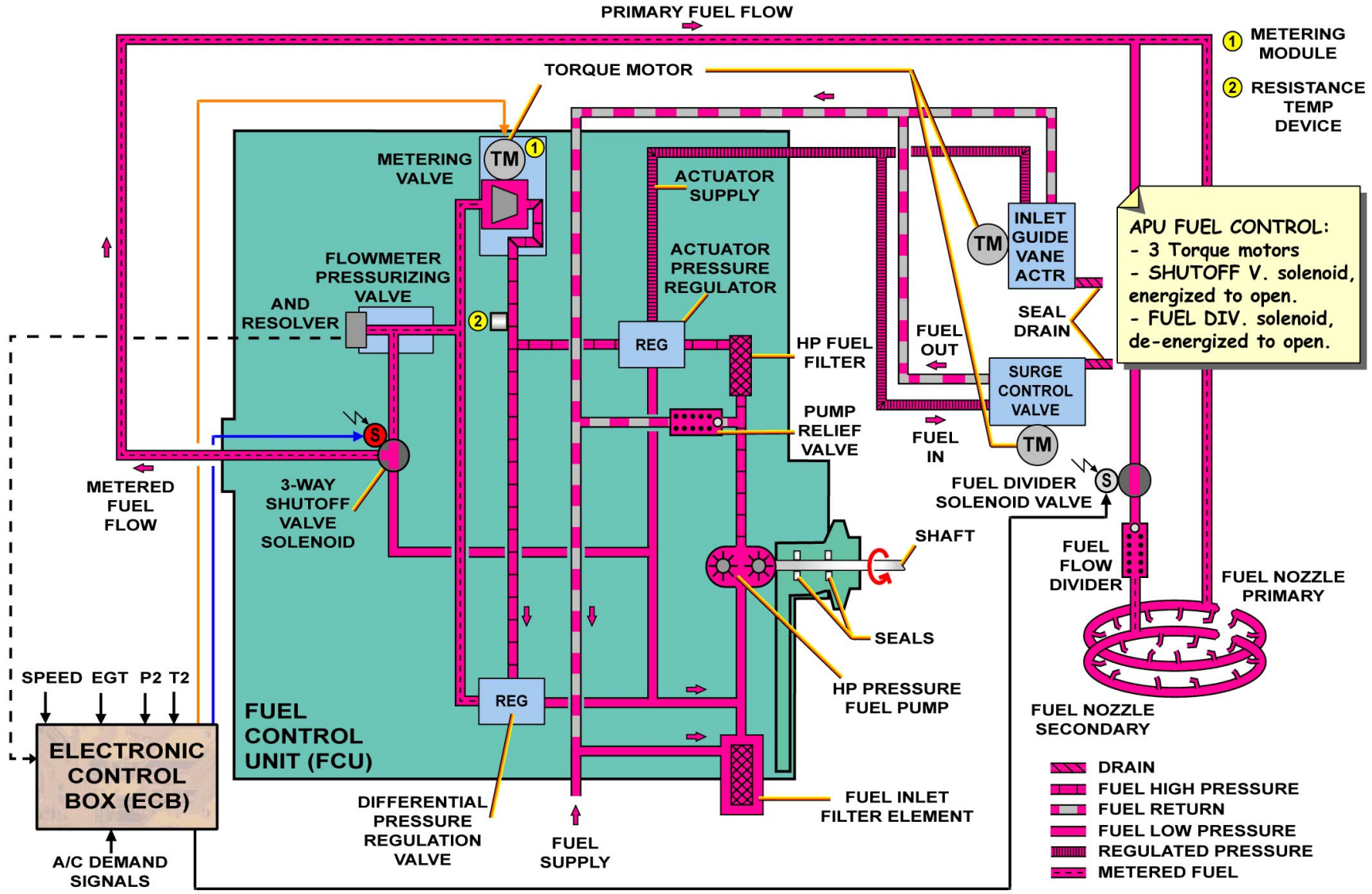

GENERAL - CONTROL

APU FUEL SYSTEM D/O (3)

FUEL CONTROL UNIT

The FCU has six functions:
- fuel filtering,
- pressure increase,
- fuel metering,
- flow meter control,
- positive fuel shut-off,
- fuel muscle pressure regulation.

The FCU is made of a LP inlet fuel filter, a High Pressure (HP) fuel pump, a pump relief valve, a HP fuel filter, an actuator pressure regulator for hydraulic fuel operation, a torque-motor metering valve, a resistance temperature device, a delta pressure regulator, a flow-meter pressurizing valve, a fuel-shutoff solenoid valve.
Fuel filter replacement is recommended every 8500 Flight Hours.

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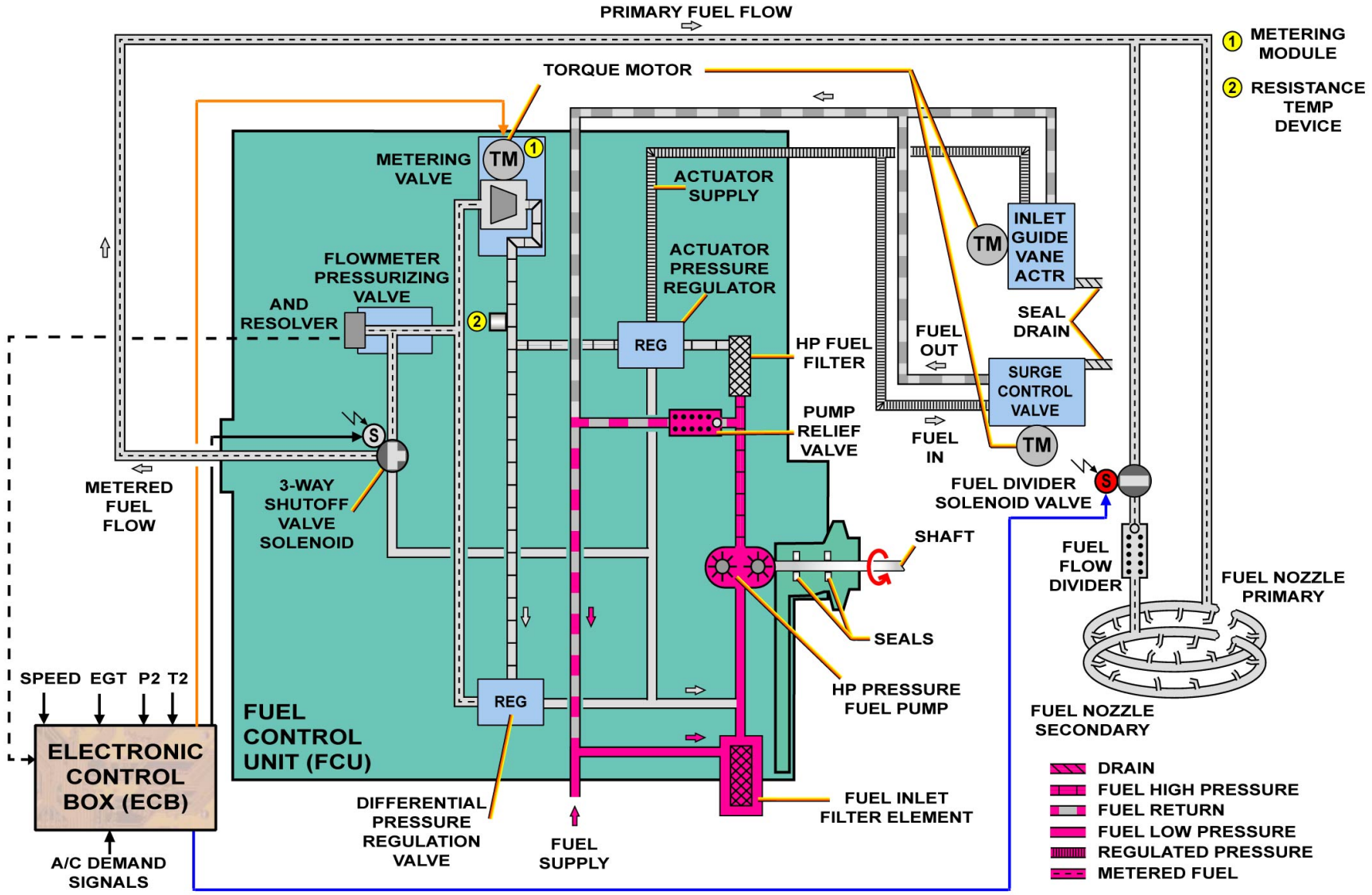

FUEL CONTROL UNIT

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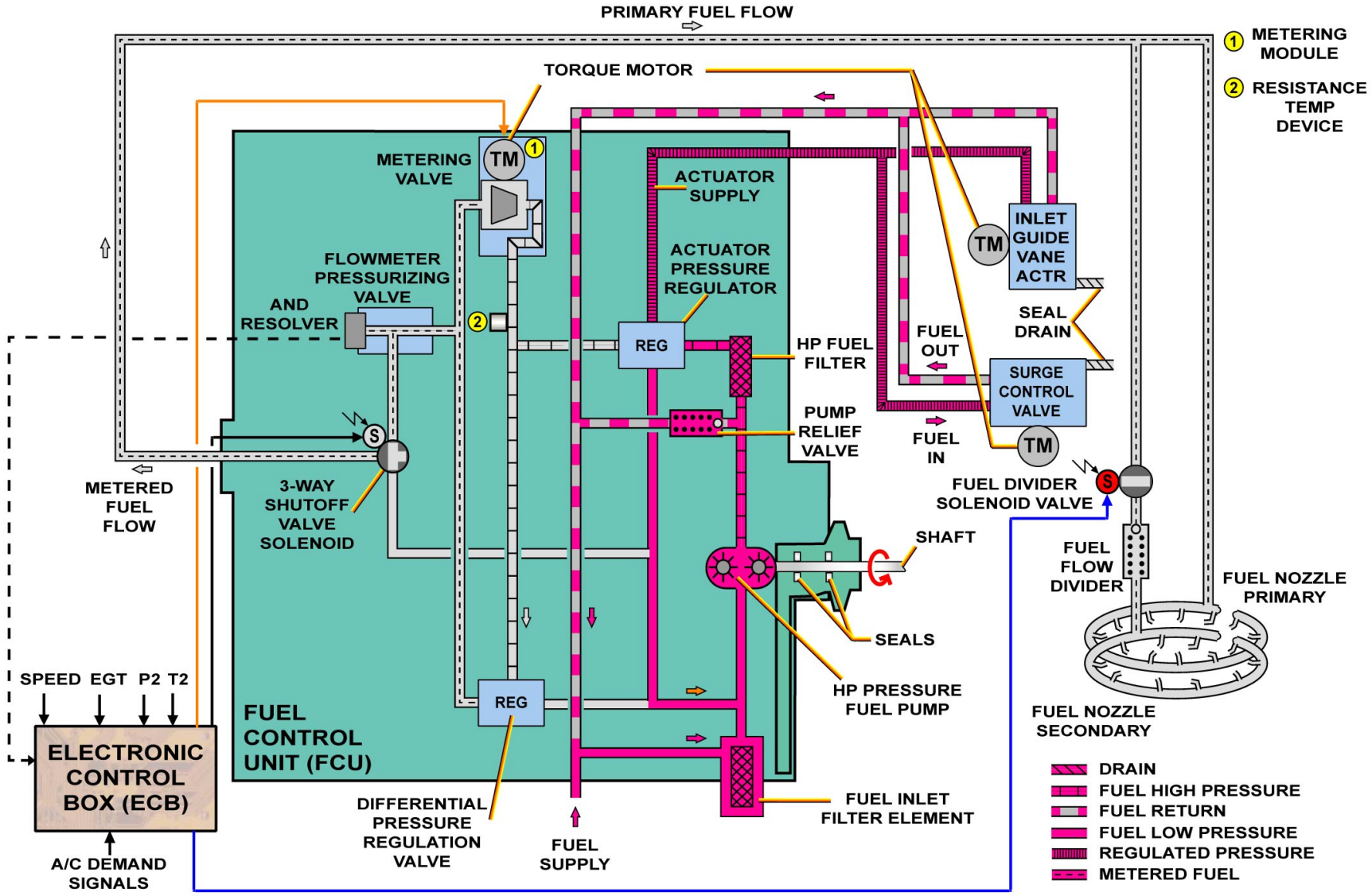
APU FUEL SYSTEM D/O (3)

MUSCLE PRESSURE

Additionally fuel muscle pressure 250 psig operates the surge control valve actuator for air release to the exhaust and the load-compressor IGV actuator. Servo fuel return goes back to the pump inlet.
From the Actuator Pressure Regulator fuel flow continues to the Metering Module and in parallel to the inlet of the Differential Pressure Regulation Valve



MUSCLE PRESSURE

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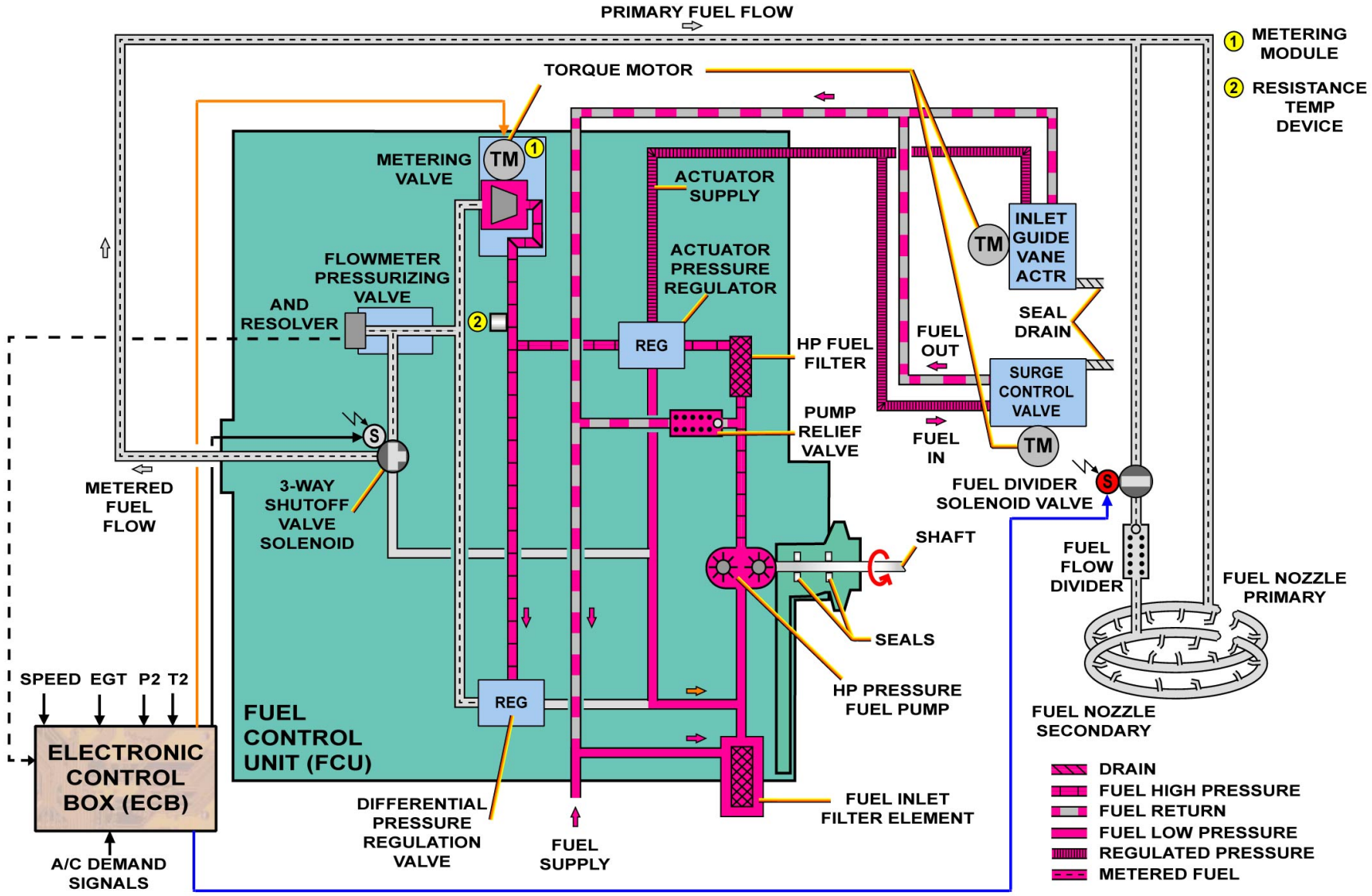

MUSCLE PRESSURE

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APU FUEL SYSTEM D/O (3)

FUEL SCHEDULE

The Electronic Control Box (ECB) controls the fuel-metering valve through a torque motor.
The ECB:
- schedules fuel flow during start sequence, on-speed operation and shutdown sequence,
- refers to information on the flowmeter pressurizing valve to correct fuel flow and in relation to the fuel temperature (resistance-temperature device signal),
- modulates the on-speed fuel schedule to agree with the aircraft demand for bleed air and electrical power.

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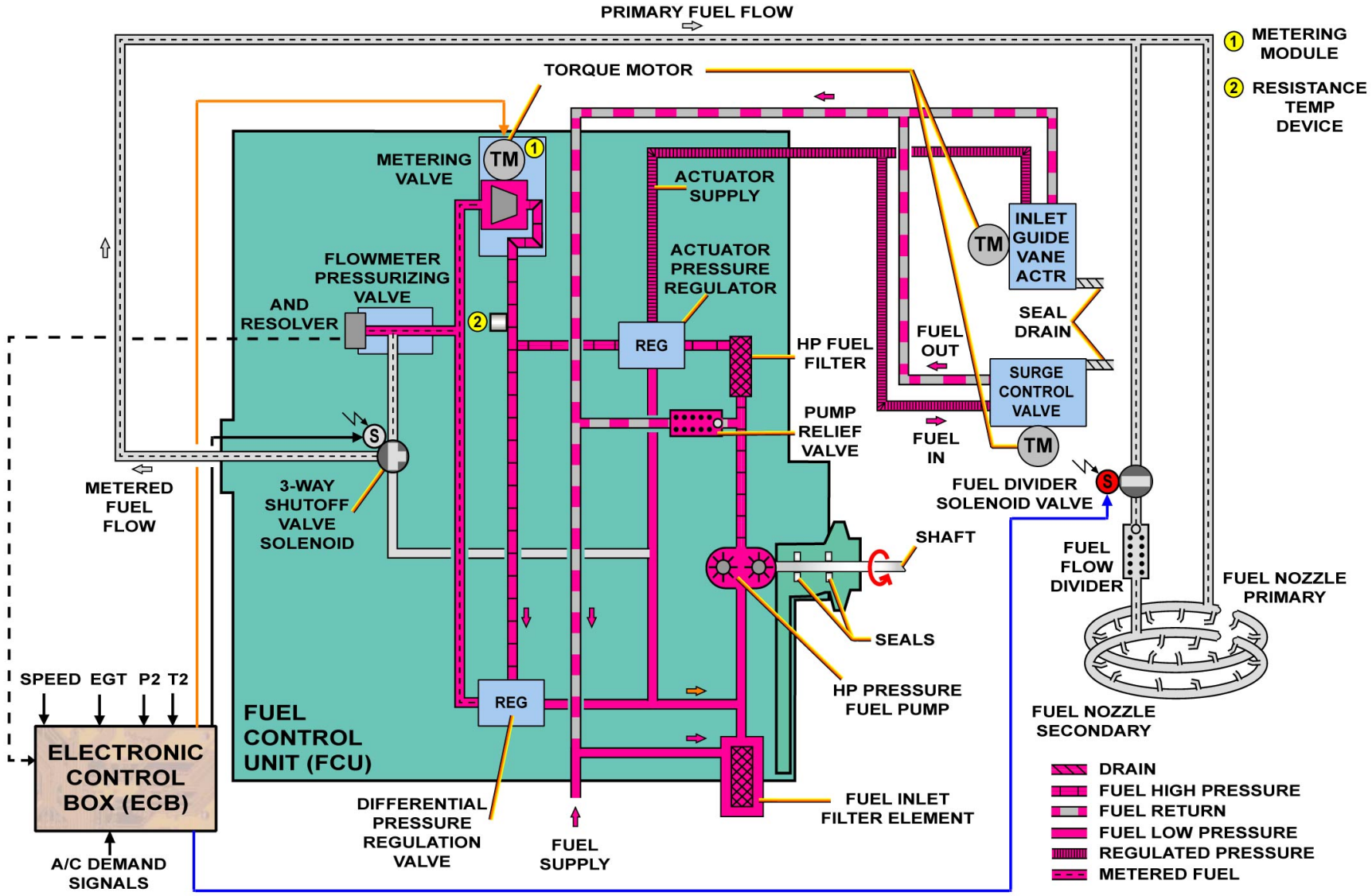

FUEL SCHEDULE

APU FUEL SYSTEM D/O (3)

FUEL SHUT-OFF

The ECB controls the fuel 3-way solenoid valve for positive fuel shut-off. The valve is controlled open during the start sequence and closed during the stop sequence. Fuel goes back to the pump inlet.

FLOW DIVIDER AND SOLENOID VALVE

The flow divider supplies fuel in sequence to the primary and secondary manifolds. It has a usually open fuel solenoid and a check valve. During cold start or high altitude operation, the ECB energizes the solenoid valve to close during the first 30% speed of the Auxiliary Power Unit (APU) and all fuel flow is pushed through the primary nozzles for better engine acceleration.

FUEL SUPPLY

Two fuel manifolds and 10 dual fuel-nozzles supply fuel. Each fuel-nozzle has a primary and a secondary fuel orifice. When APU start is selected, the primary fuel orifice is supplied and when the fuel pressure is more than 125 psig the check valve in the flow divider assembly opens to supply the secondary fuel orifice. During on-speed operation, the two orifices are supplied.

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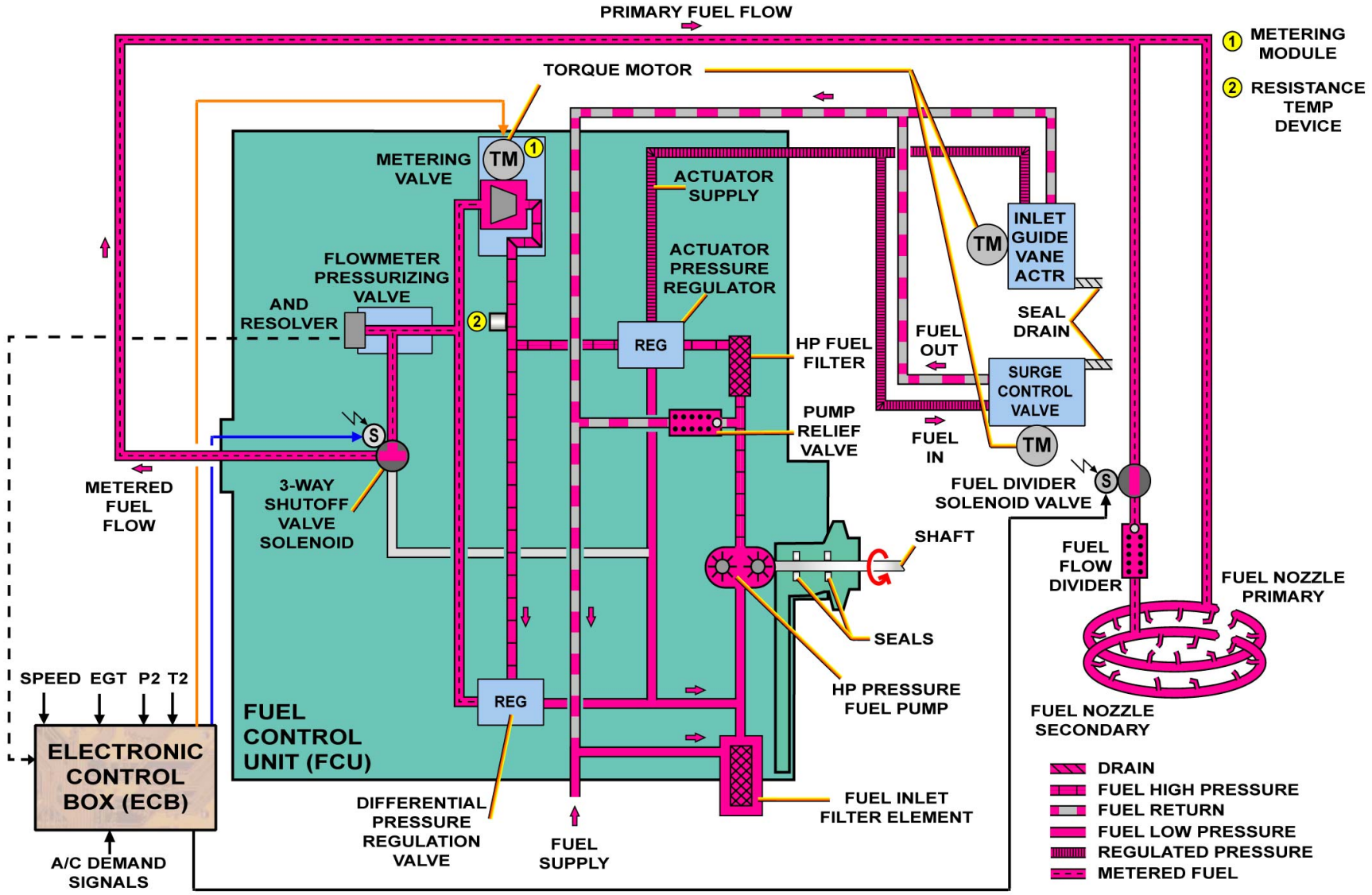

FUEL SHUT-OFF ... FUEL SUPPLY

APU FUEL SYSTEM D/O (3)

APU SHUTDOWN

The 3-Way Shutoff Solenoid Valve is brought to the closed position and the fuel is now given back to the pump inlet.
The fuel is trapped in the line to the Primary and Secondary Nozzles.
The 2 fuel manifolds are still filled up with remaining fuel.

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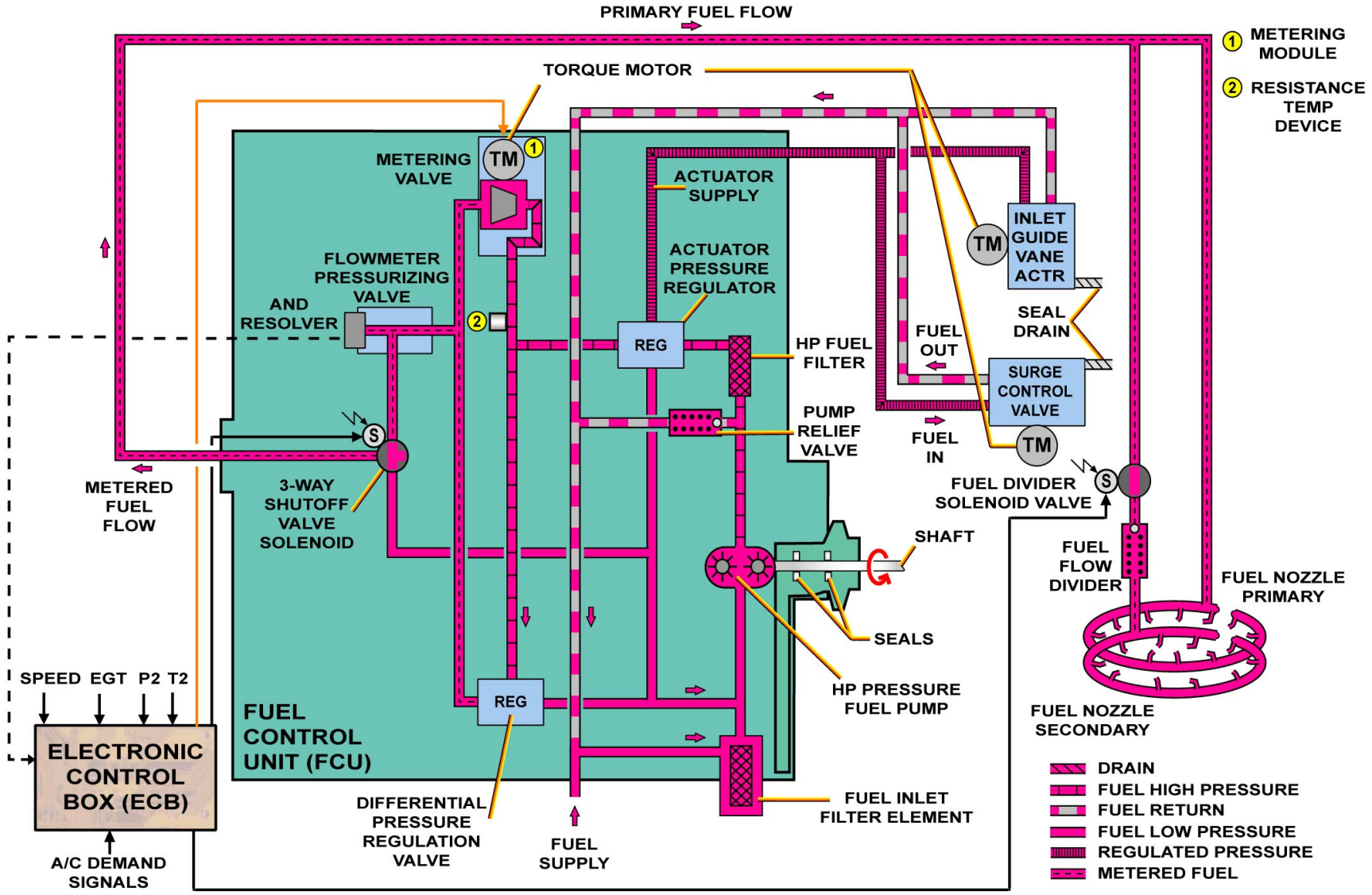

APU SHUTDOWN

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APU INDICATION SYSTEM (3)

TEMPERATURE INDICATING

EGT THERMOCOUPLE

The Exhaust Gas Temperature (EGT) thermocouples are in the APU exhaust. The EGT thermocouple is a chromel-alumel device which has two probes of different lengths. The EGT thermocouples supply a voltage in proportion to the EGT. This voltage is supplied through a shielded cable to the ECB 59KD.

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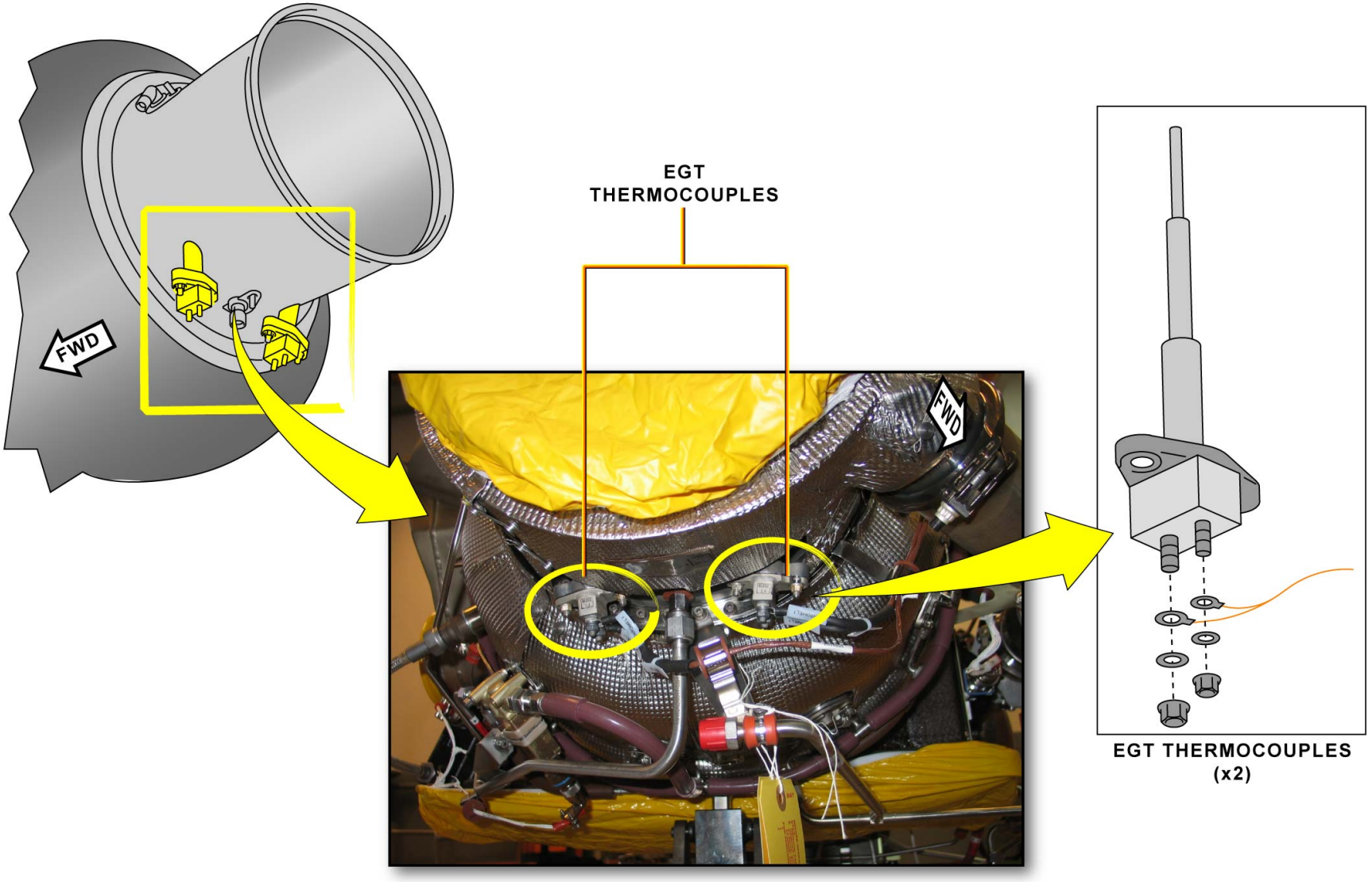

TEMPERATURE INDICATING - EGT THERMOCOUPLE

APU INDICATION SYSTEM (3)

TEMPERATURE INDICATING (continued)

TEMPERATURE MONITORING

Each thermocouple does the conversion of the thermal energy of the APU exhaust gas stream into an electrical voltage. This voltage increases in proportion to the EGT.
The ECB receives the signals of the two thermocouple rakes and makes an evaluation of the average temperature value that will be used for processing and indication. If there is a difference of 65°C (150 deg.F) between the two signals and an APU speed is above 95% of N1, the ECB uses the highest value.

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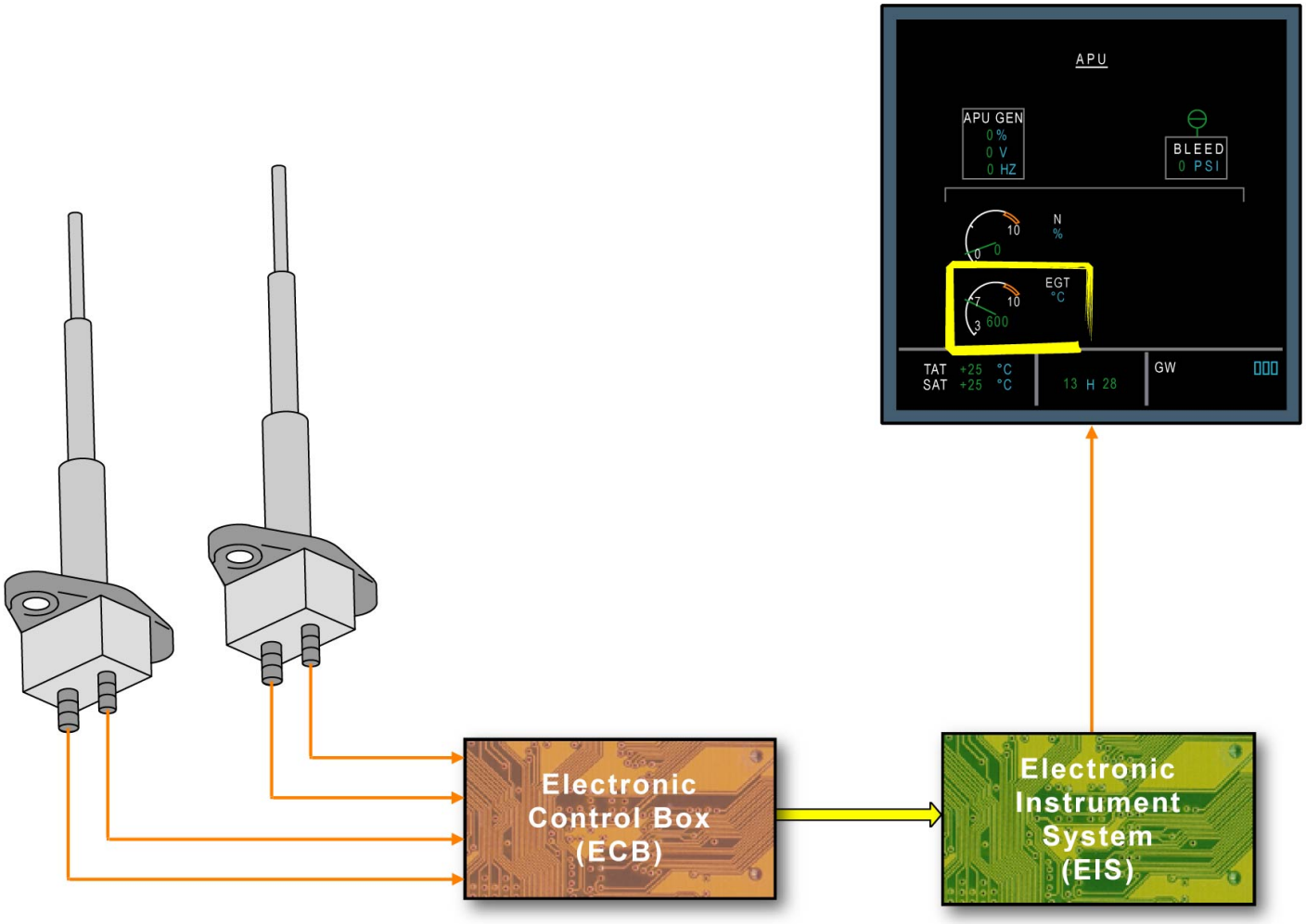

TEMPERATURE INDICATING - TEMPERATURE MONITORING

APU INDICATION SYSTEM (3)

POWER INDICATING

SPEED SENSOR

One speed sensor in installed at the bottom-right side of the gearbox.
The speed sensor includes:
- a magnetically soft-pole piece,
- a permanent magnet,
- two coils.

The movement of gear-like teeth on the compressor-turbine shaft induces an AC current in the two coils of the speed sensor. The frequency of this current is in proportion to the speed at which the APU turns.

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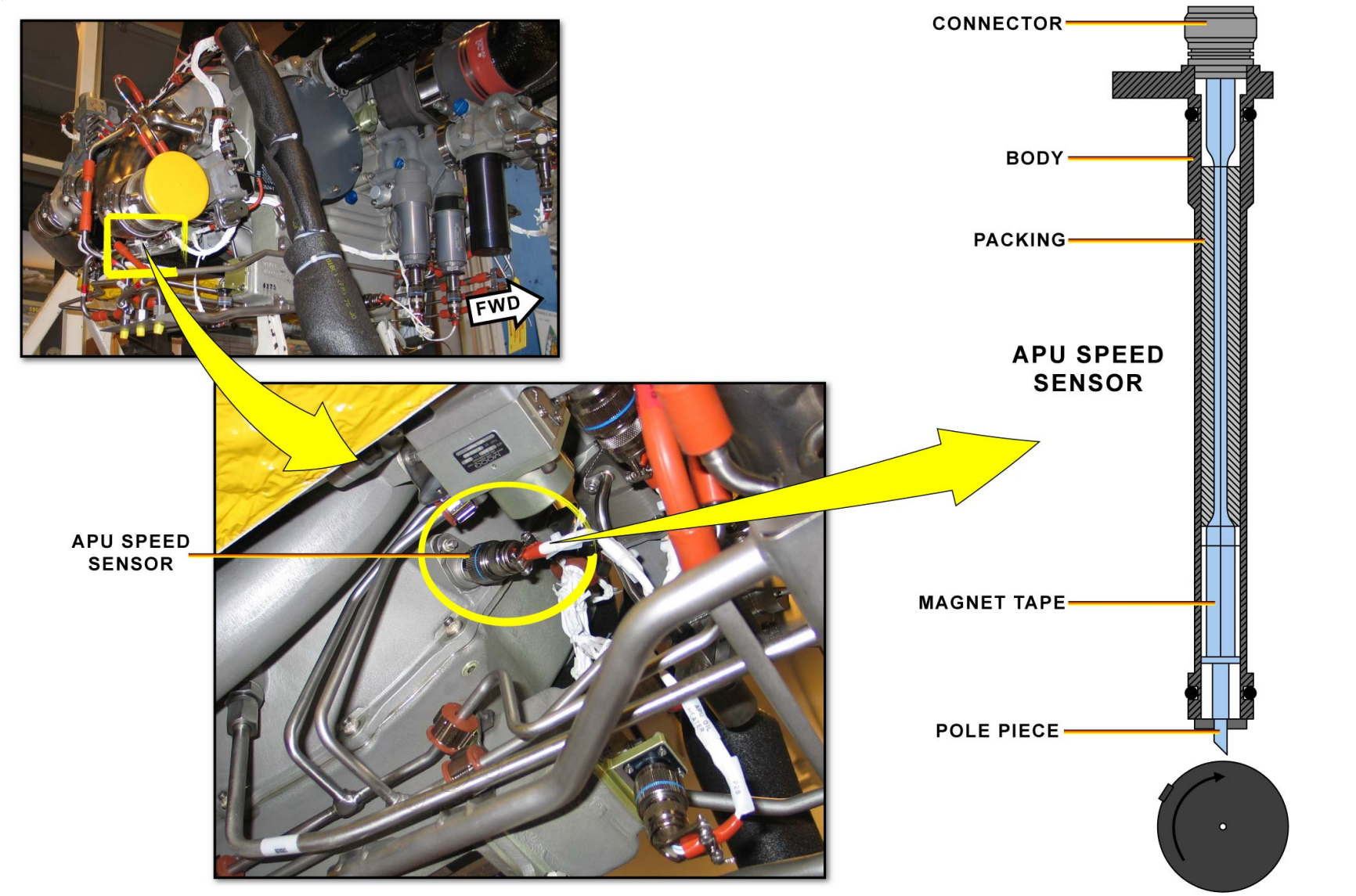


POWER INDICATING - SPEED SENSOR

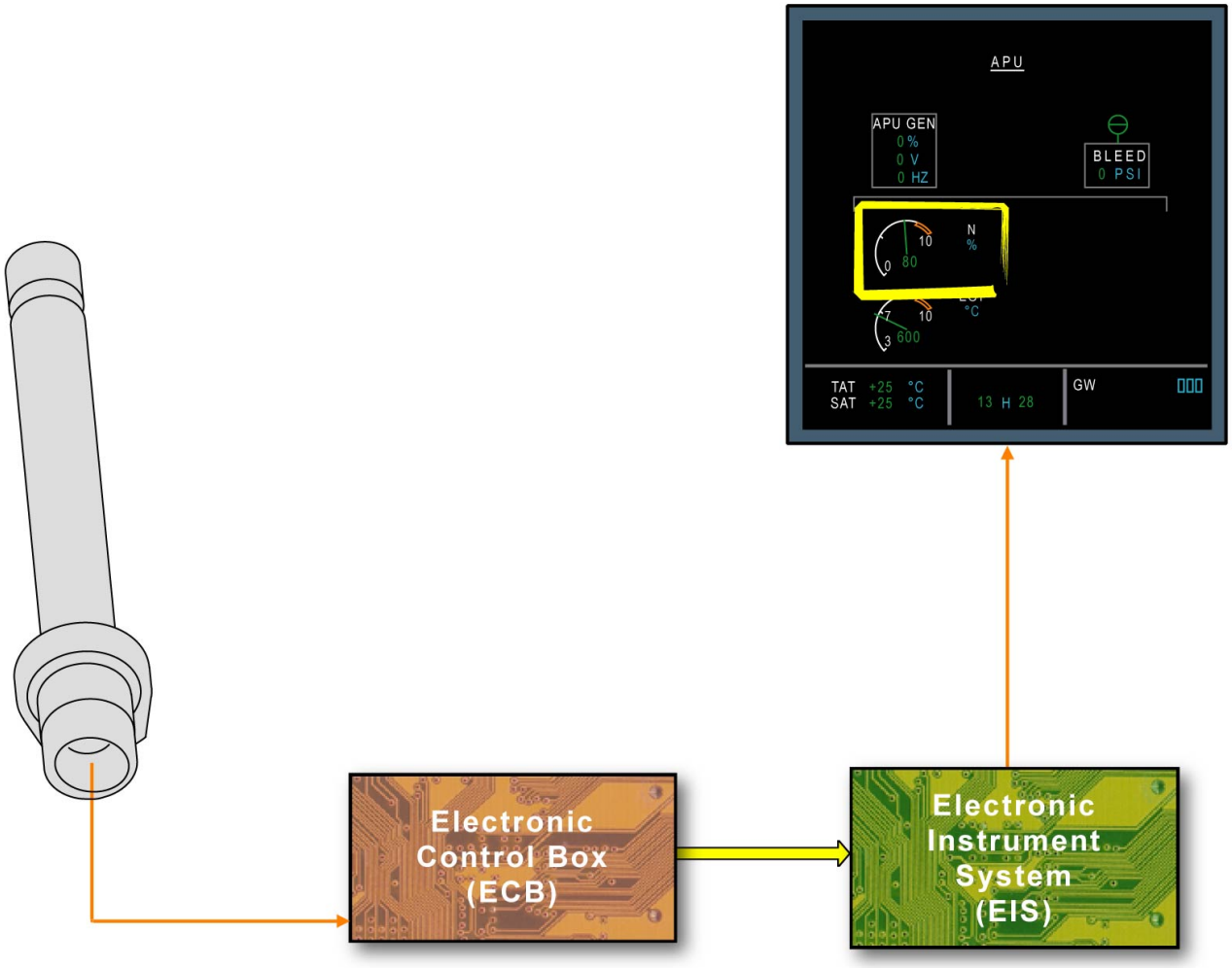
APU INDICATION SYSTEM (3)

POWER INDICATING (continued)

POWER MONITORING

The two frequency signals, which are related to the speed at which the APU turns, are transmitted to the ECB. By comparison, the ECB makes an evaluation of the highest speed signal. The signal is also transmitted through an ARINC 429 bus to EIS.
The APU SYSTEM page on the lower ECAM display unit shows the APU speed in percent.

UGB13131 - U7ST0M0 - UM49D8HONEY0001



POWER INDICATING - POWER MONITORING

APU OIL SYSTEM D/O (3)

GENERAL

The oil system of the Auxiliary Power Unit (APU) lubricates and decreases the temperature of the power section, load compressor, gearbox and AC generator.
This system is made of:
- storage,
- supply,
- scavenge,
- venting,
- control,
- protection,
- monitoring.

STORAGE

The sump of the APU Accessory Gearbox (AGB) is the oil reservoir. The AGB sump contains 6.26 l (1.65 US gal) of oil. The oil reservoir can be filled by gravity or by pressure.
The AGB has:
- an oil fill cap for gravity filling,
- optional pressure oil servicing with a pressure fill and overfill port,
- an oil-level sight glass with FULL and ADD marks,
- a magnetic chip detector and oil drain plug installed at the lowest point of the AGB,
- an oil heater.

CONTROL

The Electronic Control Box (ECB) only controls the de-oiling valve in the oil system. The de-oiling solenoid valve is electrically opened during APU start to make sure of cold start conditions and to decrease the load on the pressure pump. The solenoid valve is open during start-up to 60% RPM when:
- the oil sump temperature is below -6.7°C (+20°F),
- or the A/C altitude is above 10,000 ft (P2<10,1 psia),
- or the APU fuel temperature is below -12.2°C (+10°F).

The valve is energized open during every APU shutdown between 50% and 7% speed.

PROTECTION

The ECB gives protection to the APU if there is an oil system malfunction. The ECB monitors oil pressure and oil temperature. If one of the oil parameters is out of limit, the ECB starts an automatic APU shutdown without time delay:
- gearbox high oil temp threshold: 162.78°C (325°F),
- oil low pressure: 33 psi.

The ECB also stops the APU if a delta pressure switch at the scavenge filter or at the lubrication filter shows impending filter clogging.

MONITORING

The oil system is monitored to increase the APU life. The oil sump is installed with a low-level switch to show maintenance information in the cockpit. When the level is at the "ADD" mark 4.60 l (1.22 US gal), the APU can continue to operate for 10 hours maximun. This changes with the different operating attitudes of the A/C in flight. A magnetic drain plug, put fully in the APU oil, lets the oil drain from the sump and attracts ferrous metal particles.

OIL HEATER (OPTION)

The control of the oil heater is independent of the ECB. When the oil temperature is below 16 °C (61 °F) and the APU master switch is released out, the heater is supplied with 115VAC.
The oil heater is switched off when the oil temperature increases above 49°C (120 °F) or the master switch is selected ON.
The oil heater is an option.

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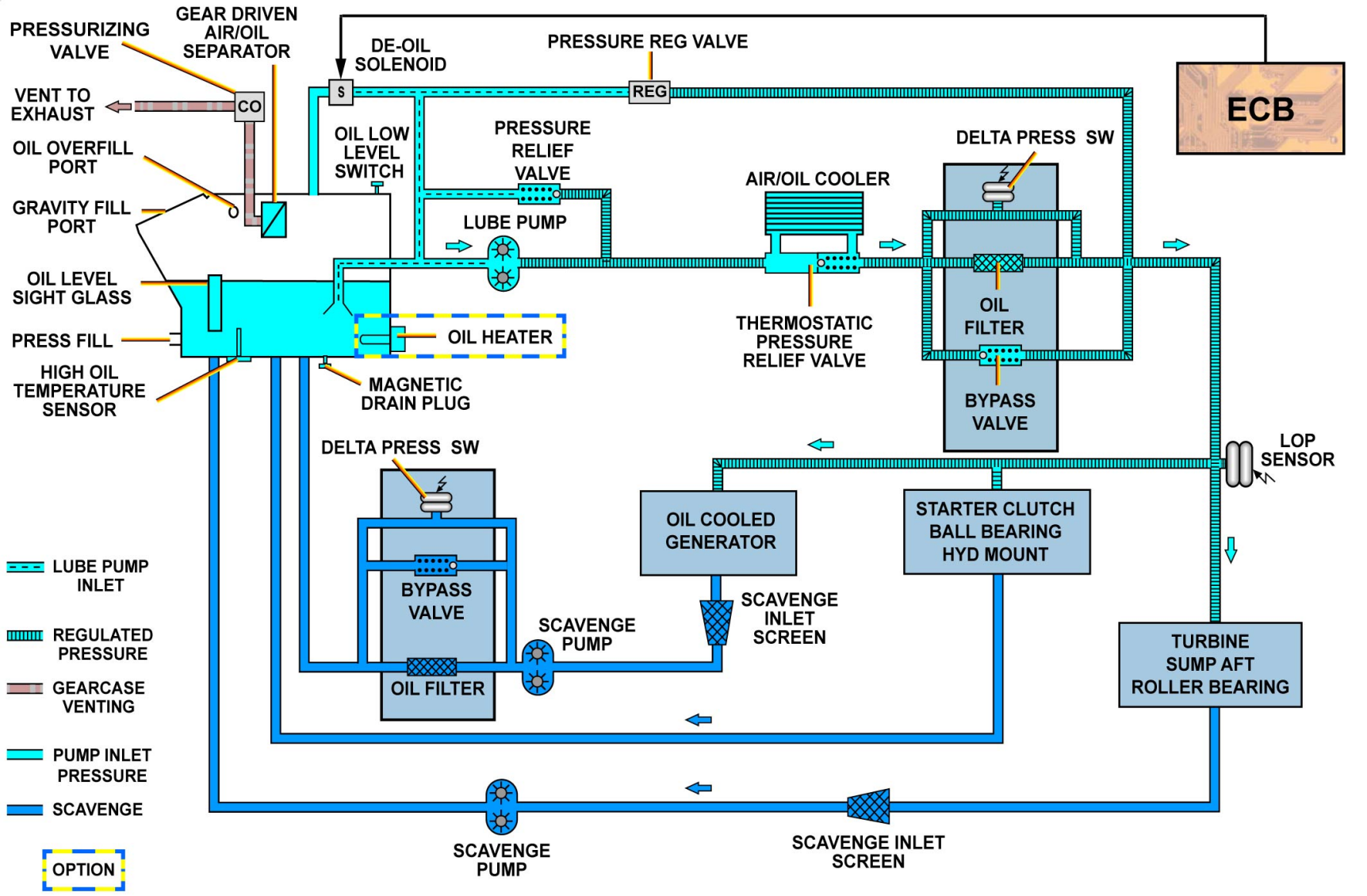
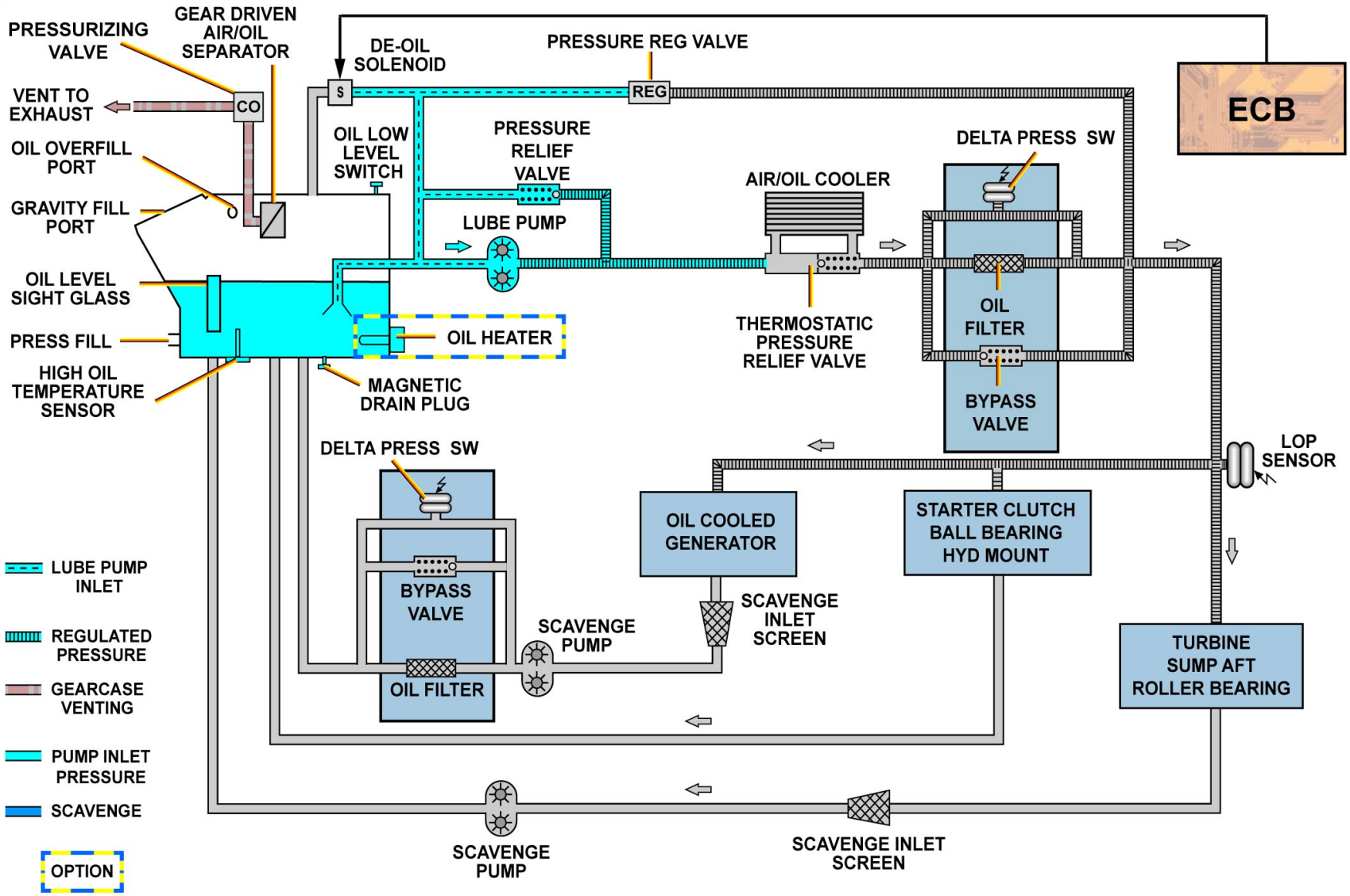


GENERAL & OIL HEATER (OPTION)

APU OIL SYSTEM D/O (3)

SUPPLY

A three-element gerotor pressure pump pulls the oil from the sump. A pressure-regulating valve and ultimate-relief valve assembly keeps a constant lube supply pressure for oil supply to the engine and generator and prevents over-pressurization of the lube system.
Pressure-regulated oil goes through a cooler and a disposable filter. The bypass valve opens at an oil temperature below 60°C (140 °F) or when there is a differential pressure between 55 - 60 psi around the oil cooler.
The oil is then sent to the cooling fan splines, the APU spline shaft, the APU supporting bearings rear and front, the gearbox pinions and the electrical AC generator.



SUPPLY

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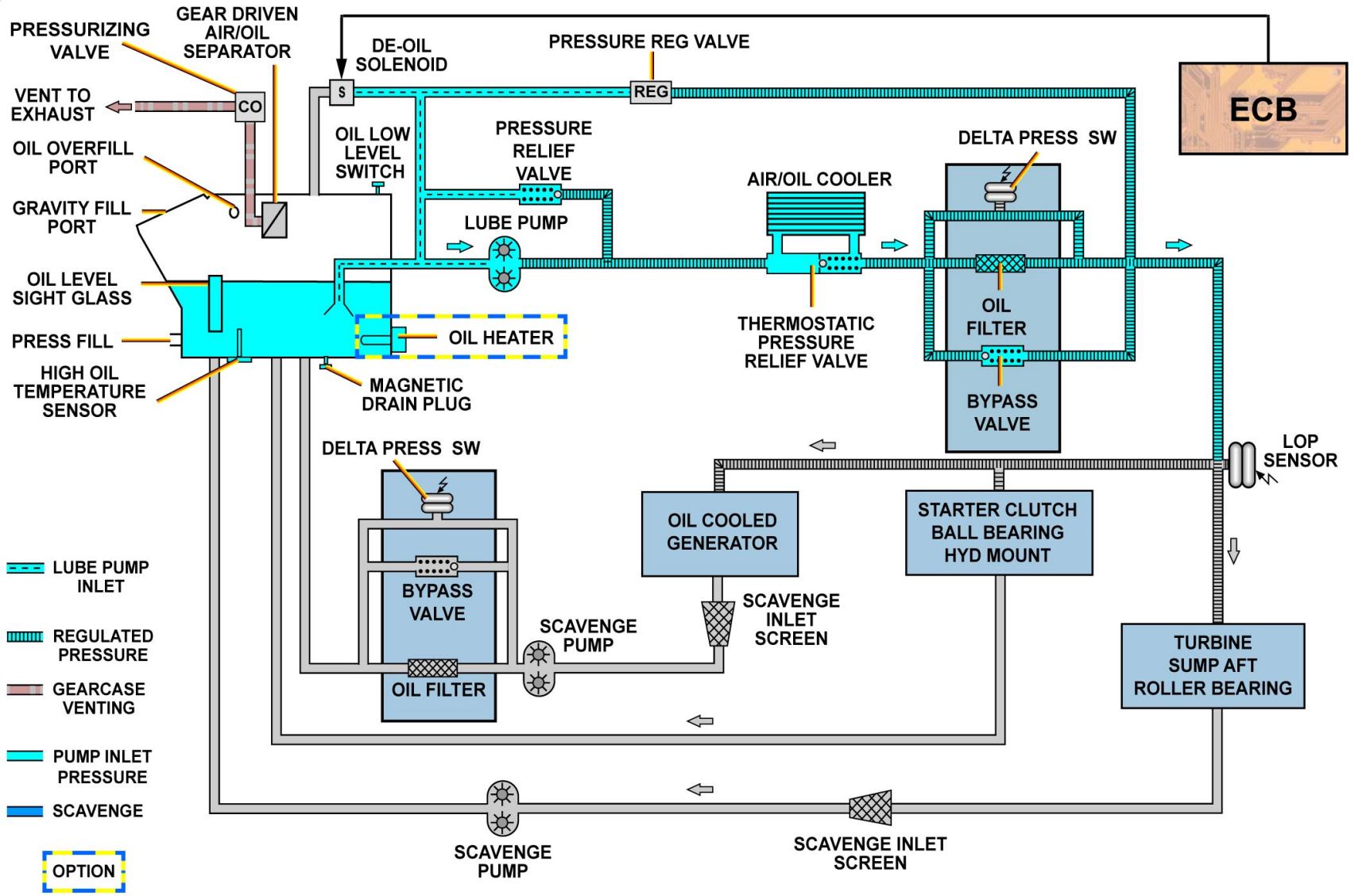
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DE-OIL SOLENOID
PRESSURE REG VALVE
ECB
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OIL LOW LEVEL SWITCH
PRESSURE RELIEF VALVE
DELTA PRESS SW
AIR/OIL COOLER
GRAVITY FILL PORT
LUBE PUMP
OIL LEVEL SIGHT GLASS
OIL FILTER
THERMOSTATIC PRESSURE RELIEF VALVE
PRESS FILL
OIL HEATER
HIGH OIL TEMPERATURE SENSOR
MAGNETIC DRAIN PLUG
BYPASS VALVE
LOP SENSOR
DELTA PRESS SW
OIL COOLED GENERATOR
STARTER CLUTCH BALL BEARING HYD MOUNT
BYPASS VALVE
SCAVENGE INLET SCREEN
SCAVENGE PUMP
TURBINE SUMP AFT ROLLER BEARING
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LUBE PUMP INLET
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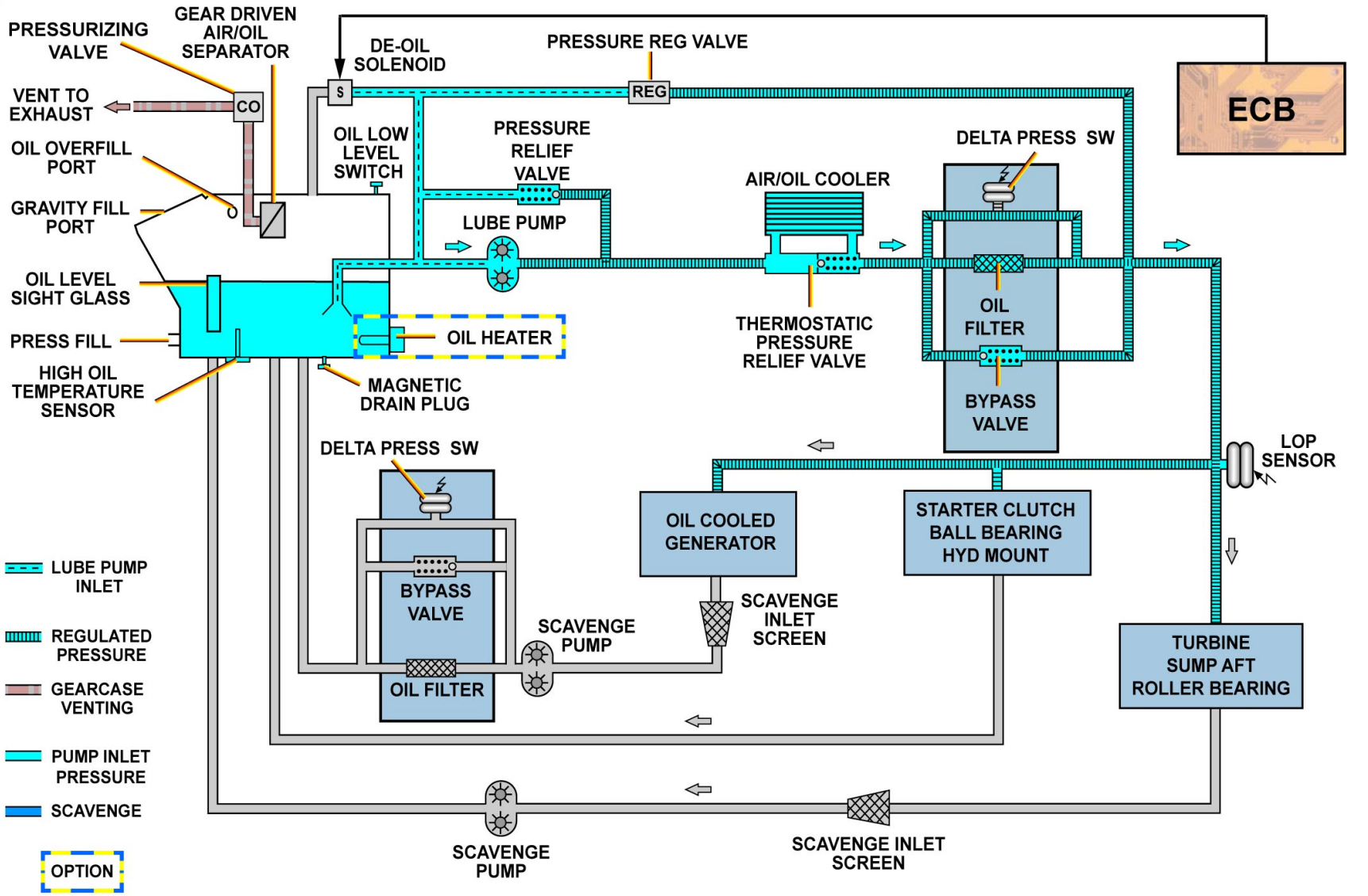
SUPPLY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PUMP INLET PRESSURE
SCAVENGE
OPTION
SCAVENGE PUMP
SCAVENGE INLET SCREEN

SUPPLY

APU OIL SYSTEM D/O (3)

SCAVENGE

The scavenged oil from the turbine sump is returned to the oil reservoir with one scavenge pump.
The oil which lubricates the gears, the starter clutch and bearings of the gearbox, is returned to the reservoir by gravity.
The scavenged oil from the generator sump is returned to the oil reservoir with one scavenge pump.
The generator scavenge oil is filtered from the generator scavenge oil-filter and then supplied to the oil reservoir. This makes sure that no contaminated oil returns from the generator to the oil reservoir.

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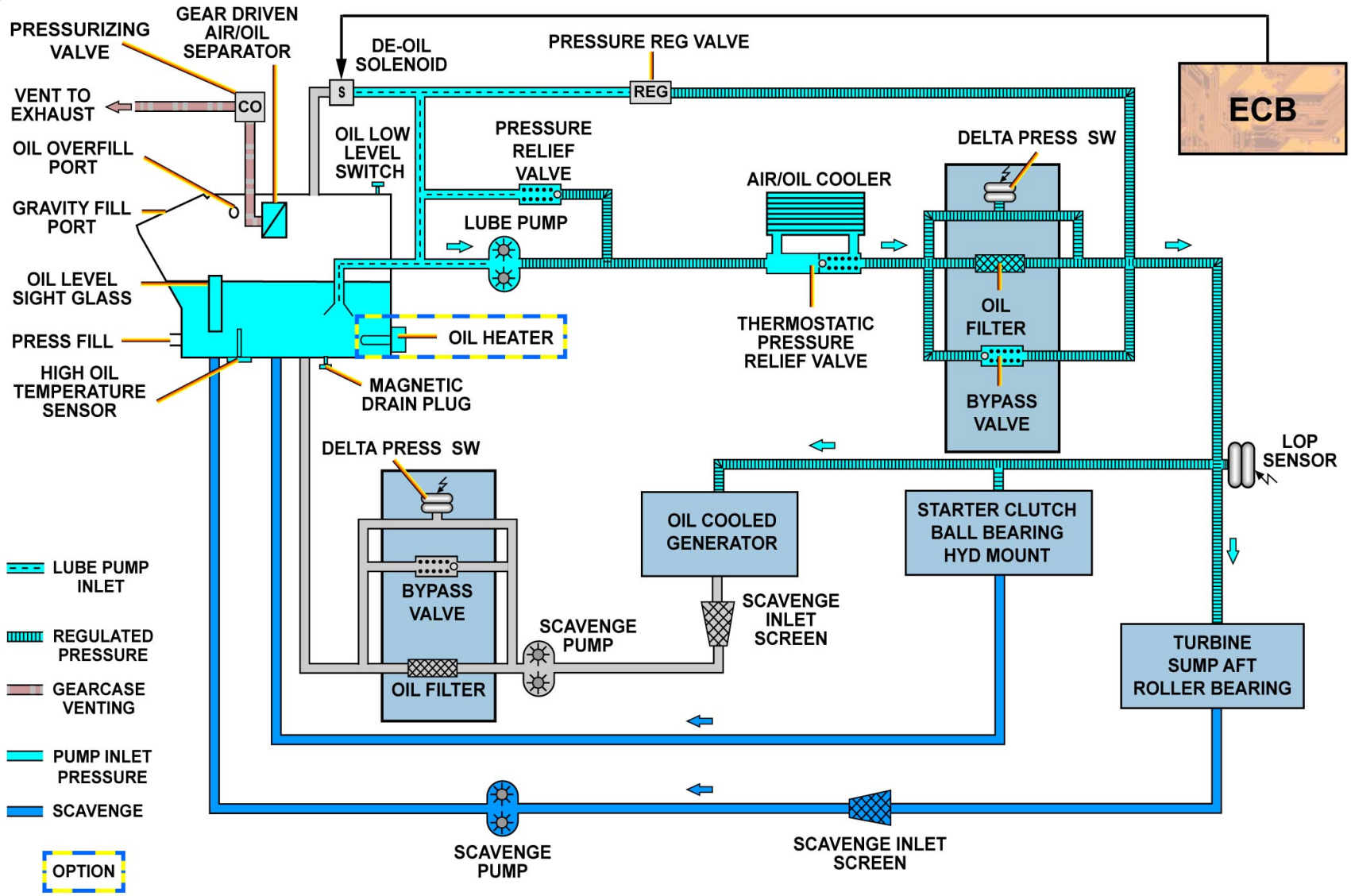

SCAVENGE

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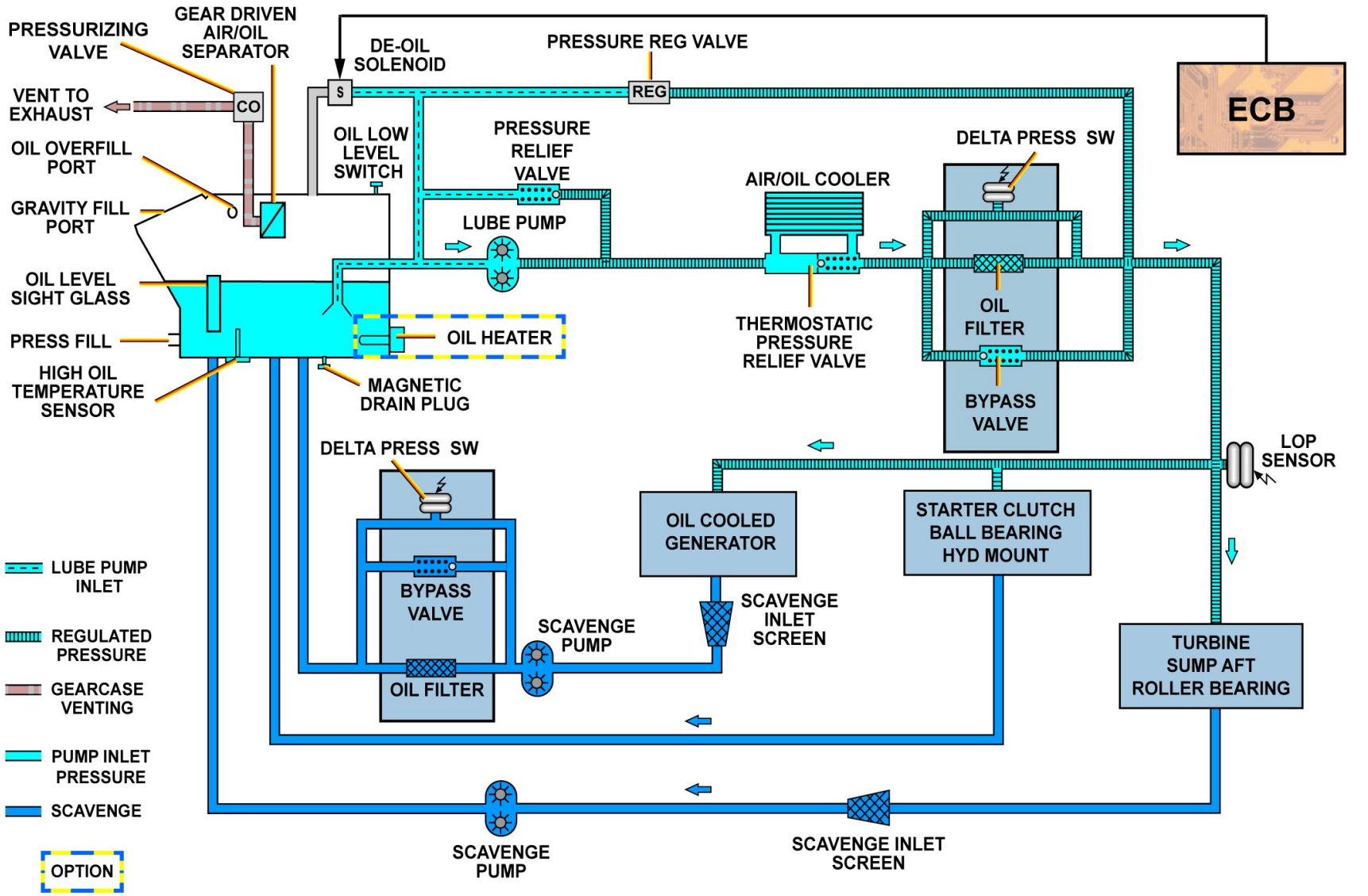
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SCAVENGE

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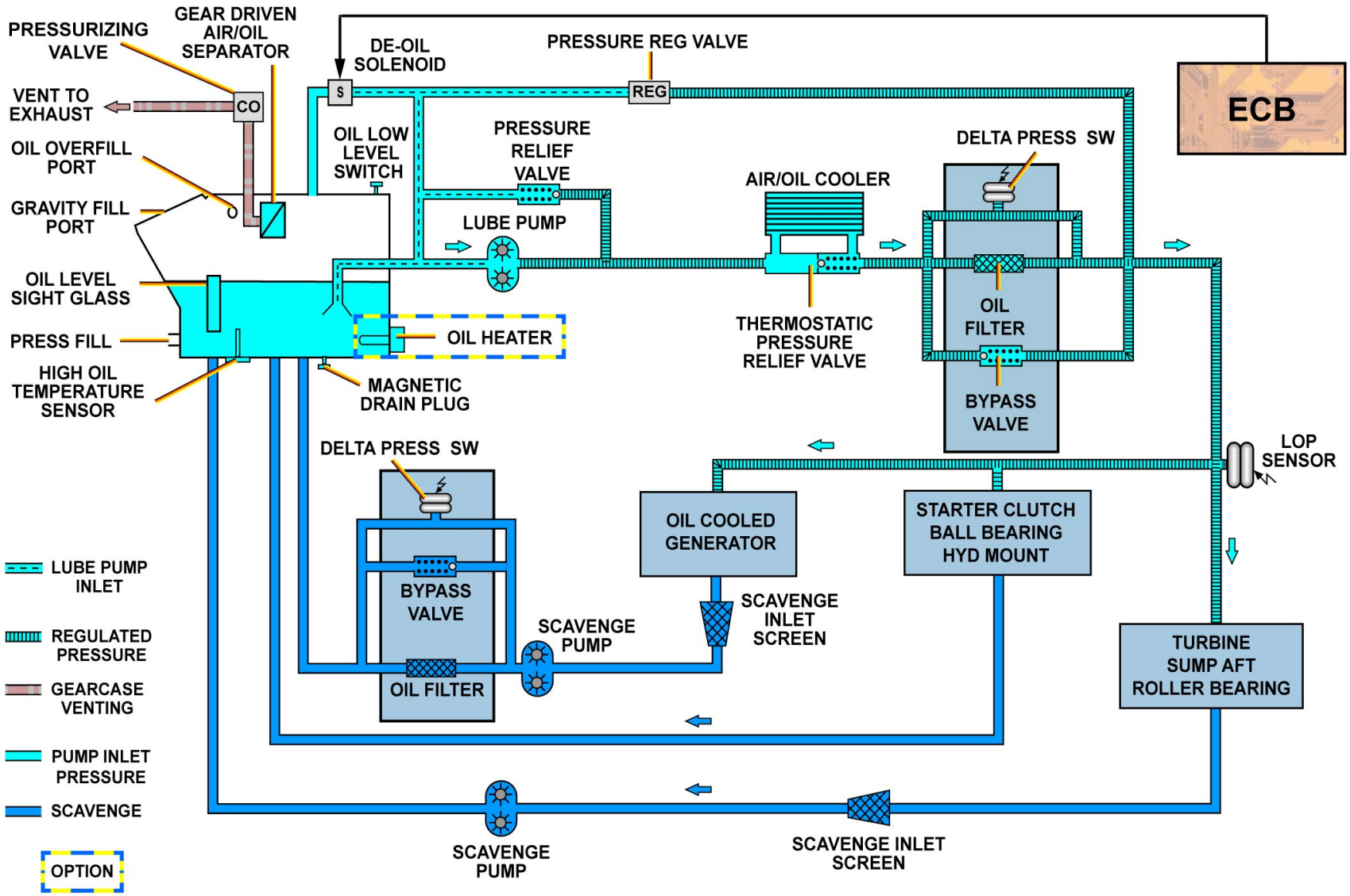
APU OIL SYSTEM D/O (3)

VENTING

The oil from the generator is sent against the gearbox wall; this removes the air, that is mixed with the oil. An air/oil separator removes the oil particles from the gearbox air. This oil-free air is released in the APU exhaust.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SCAVENGE INLET SCREEN

VENTING

APU OIL SYSTEM D/O (3)

DE-OILING SOLENOID

The only component of the oil system controlled by the Electronic Control Box (ECB) is the de-oiling valve.

DURING COLD START

During the cold start condition; the oil has a high viscosity. The de-oiling solenoid valve reduces the oil pressure pump load during the APU start by allowing air to enter the inlet of the oil supply pump. The solenoid valve is open during start up to 60% rpm when the oil sump temperature is below -6.7 deg.C (+19.94 deg.F) or the aircraft altitude is more than 20,000 ft or the fuel temperature is below -12.2 deg.C (+10.04 deg.F).

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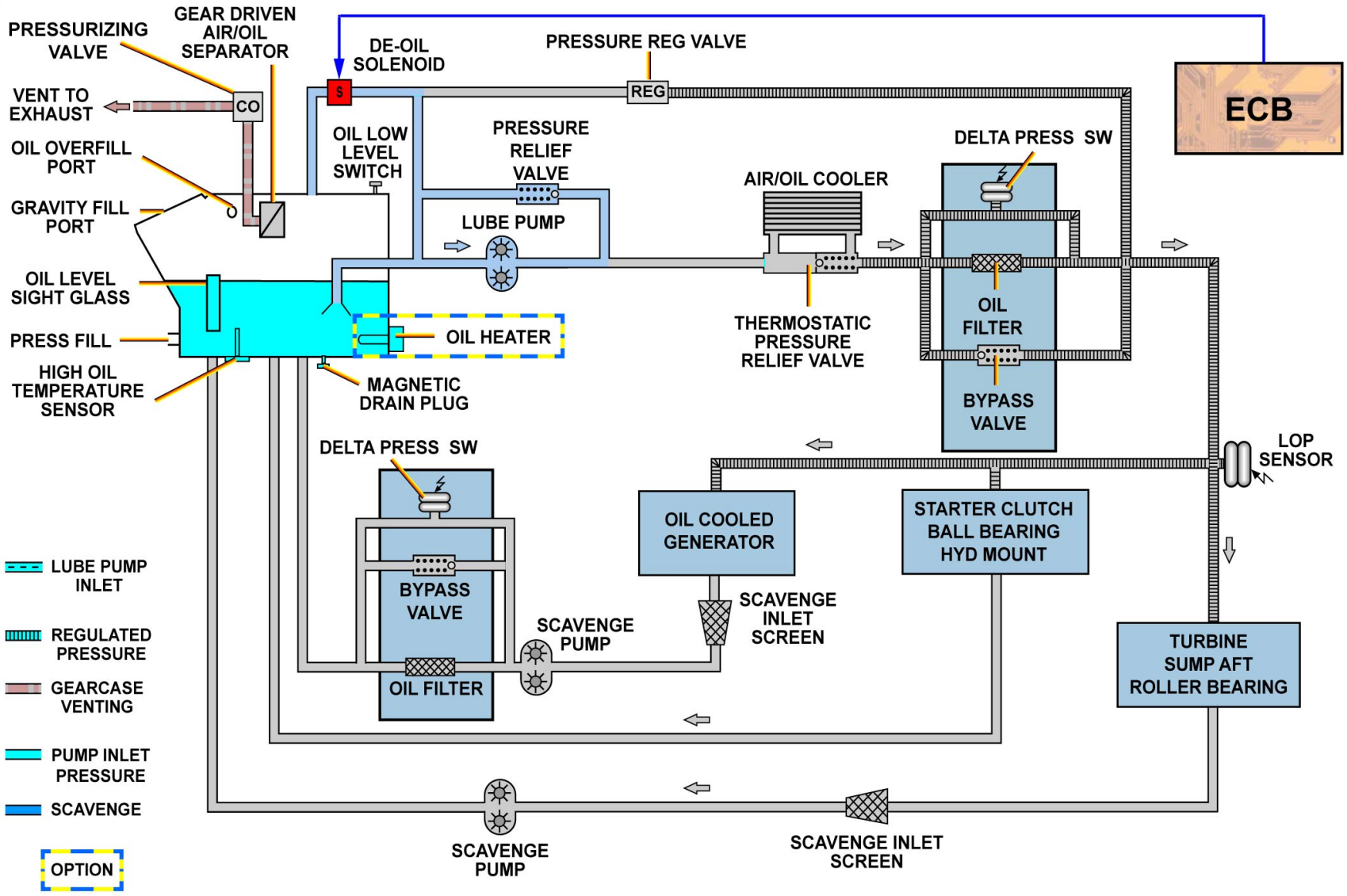


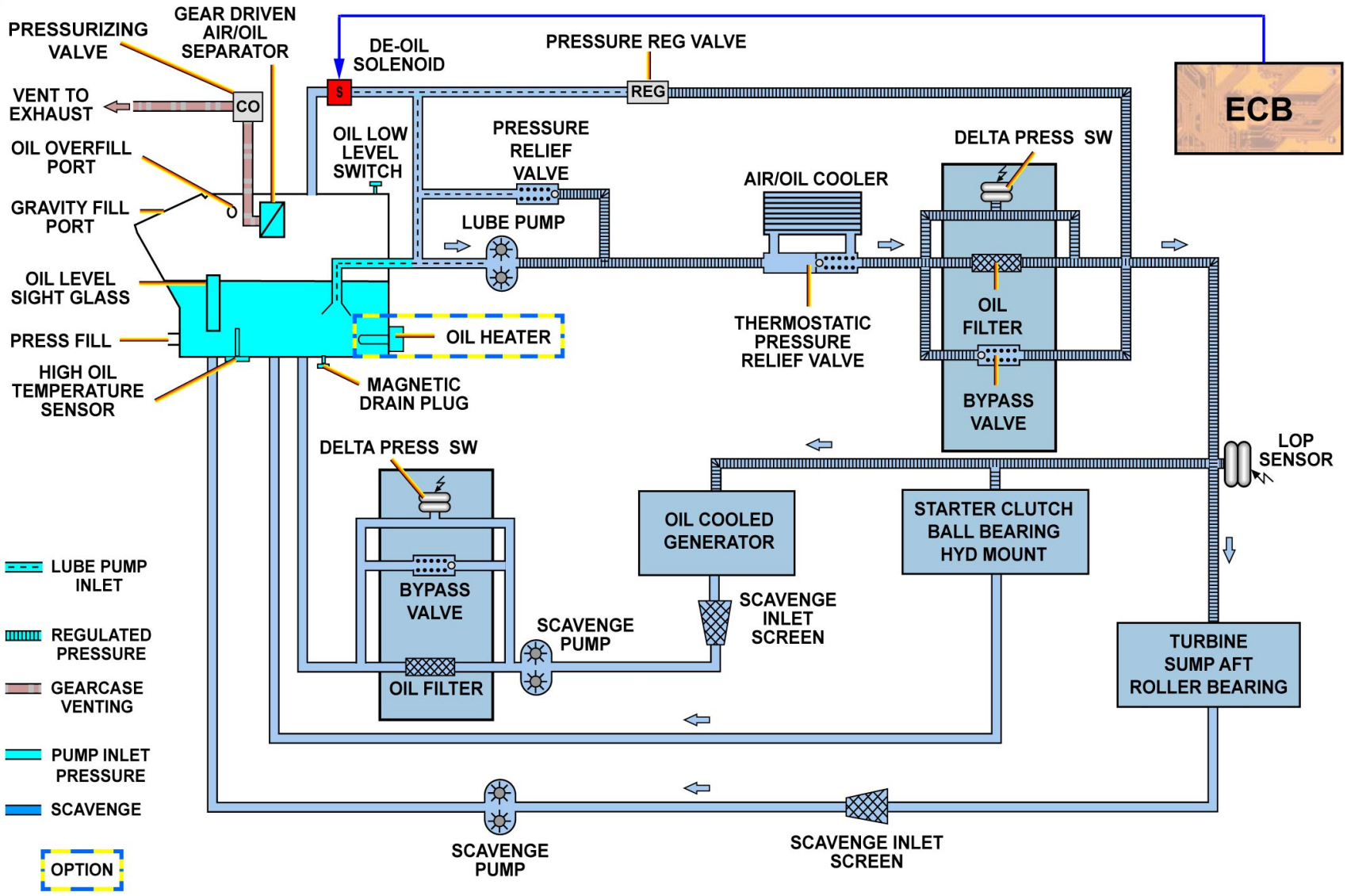
DE-OILING SOLENOID - DURING COLD START

APU OIL SYSTEM D/O (3)

DE-OILING SOLENOID (continued)

DURING SHUT DOWN

During the APU shutdown, the de-oiling solenoid valve prevents the coking of the oil remaining in the bearing chambers.
Therefore the ECB opens the de-oiling solenoid valve during shut down between 55% - 7%.



DE-OILING SOLENOID - DURING SHUT DOWN

APU AIR SYSTEM D/O (3)

GENERAL

The Auxiliary Power Unit (APU) load compressor supplies the APU bleed air. The quantity changes with the different bleed air demands of the pneumatic system. This system includes:
- bleed supply,
- bleed control,
- surge protection,
- oil cooling,
- compartment cooling,
- oil vent,
- control,
- monitoring.

BLEED SUPPLY

Bleed air supply to the A/C pneumatic system is controlled by a load control valve. The pneumatically-actuated CLOSE/OPEN butterfly valve, which allows or stops the bleed airflow from the APU to the A/C users, is controlled by the Electronic Control Box (ECB) and opens when the APU BLEED P/BSW is set to the ON position. The "APU BLEED" P/B sends "ON" signal to the ECB via the Bleed Monitoring Computer (BMC).

BLEED CONTROL

The quantity of air necessary to the aircraft bleed users is controlled by the opening angle of the load compressor Inlet Guide Vanes (IGVs). The IGVs are moved by a fuel-powered actuator (IGC-Actuator). Pressurized fuel is supplied by the internal pressure regulator part of the APU Fuel Control Unit.

SURGE PROTECTION

Load compressor surge protection is ensured by a surge control valve, which discharges the excess of air in the exhaust. The surge control valve is hydraulically operated for accurate and fast operation. The hydraulic fluid is high pressure fuel from the Fuel Control Unit (FCU) with approximately 250 psig.

OIL COOLING

A gearbox-driven fan draws air from the inlet plenum and forces it to pass through the oil cooler. After leaving the oil cooler, the air is discharged overboard.

COMPARTMENT COOLING

Air supplied by the fan, driven by one of the gears of the gearbox, is also used for APU compartment cooling. Cooling air flows through the outlets located on the cooling fan outlet duct. Natural convection ventilates the APU compartment through a vent grill in the upper left area of the compartment when the APU is not in operation.

OIL VENT

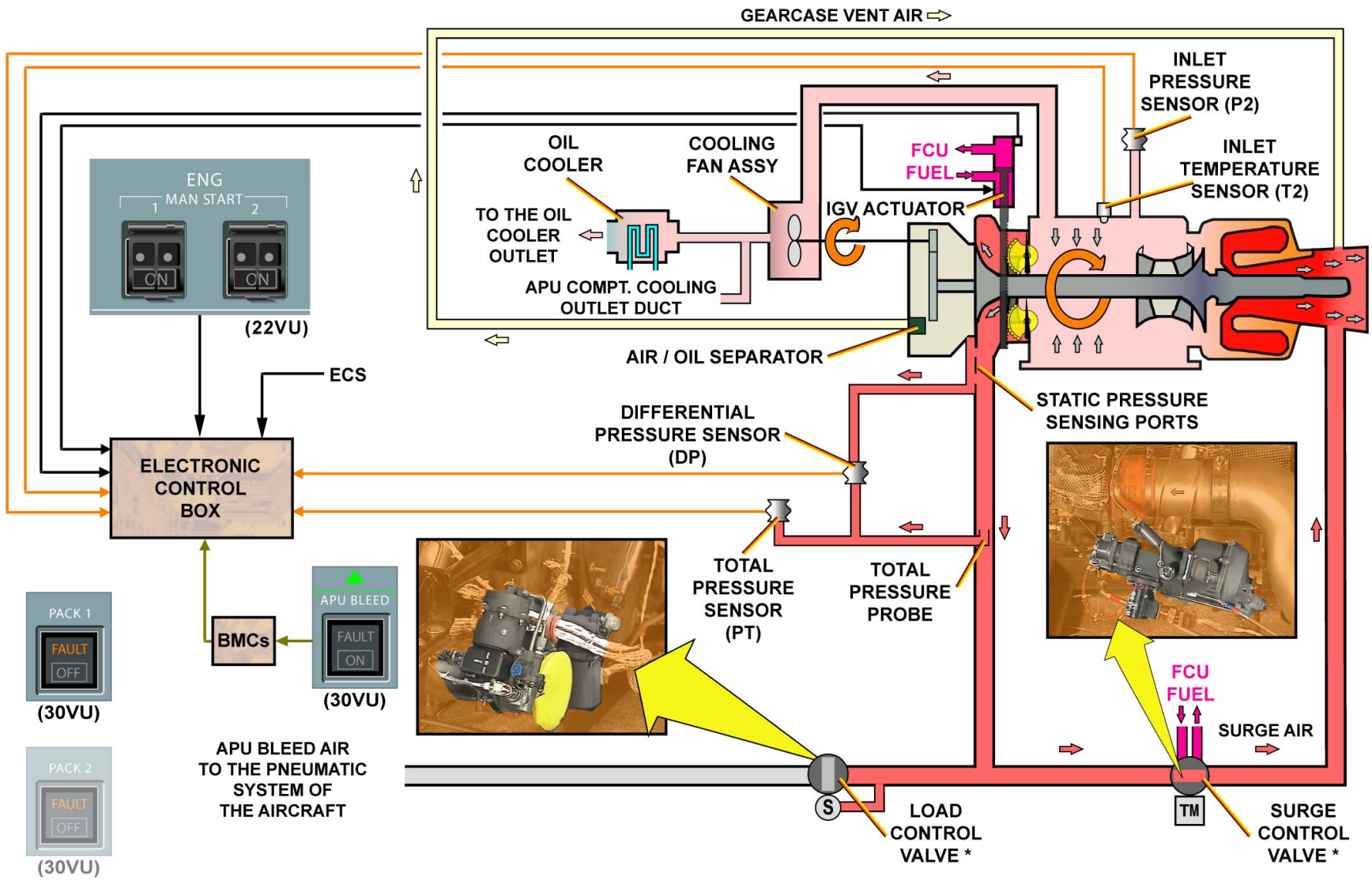
The gearbox is vented to the APU exhaust. The air is bled after an air/oil separator action.

CONTROL

The ECB controls the air system using several parameters from the following components installed on the APU:
- APU inlet pressure (P2) and temperature (T2) sensors,
- load compressor discharge pressure sensor (PT) and differential pressure sensor (DP),
- command and feedback signals from the actuators and the valves (IGV actuator, Load Control Valve and Surge Control Valve),
- A/C demands: Main Engine Start (MES) and Environmental Control System (ECS).

MONITORING

To help maintenance and troubleshooting, the load control valve and the surge control valve are equipped with visual position indicators.
The ECB receives feed back signals about the position of the IGVs, the load control valve and the surge control valve.



GENERAL ... MONITORING

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APU AIR SYSTEM D/O (3)

APU RUNNING AT 99%

BLEED PUSH BUTTON ON

After the APU Bleed P/B is pushed, the blue ON light in the P/B comes on and a signal is sent to the two BMCs and to the ECB to open the Load Control Valve (LCV).
The LCV Solenoid will be energized to let the LCV open and to let bleed air flow into the supply duct of the Aircraft pneumatic system.
To make sure a pressure build-up occurs in the Aircraft Bleed supply duct, the ECB commands the Surge Control Valve (SCV) to the closed position and then to modulate to prevent surge conditions.
The LCV (through a micro-switch) and the SCV (with an LVDT) send valve position feed back to the ECB.

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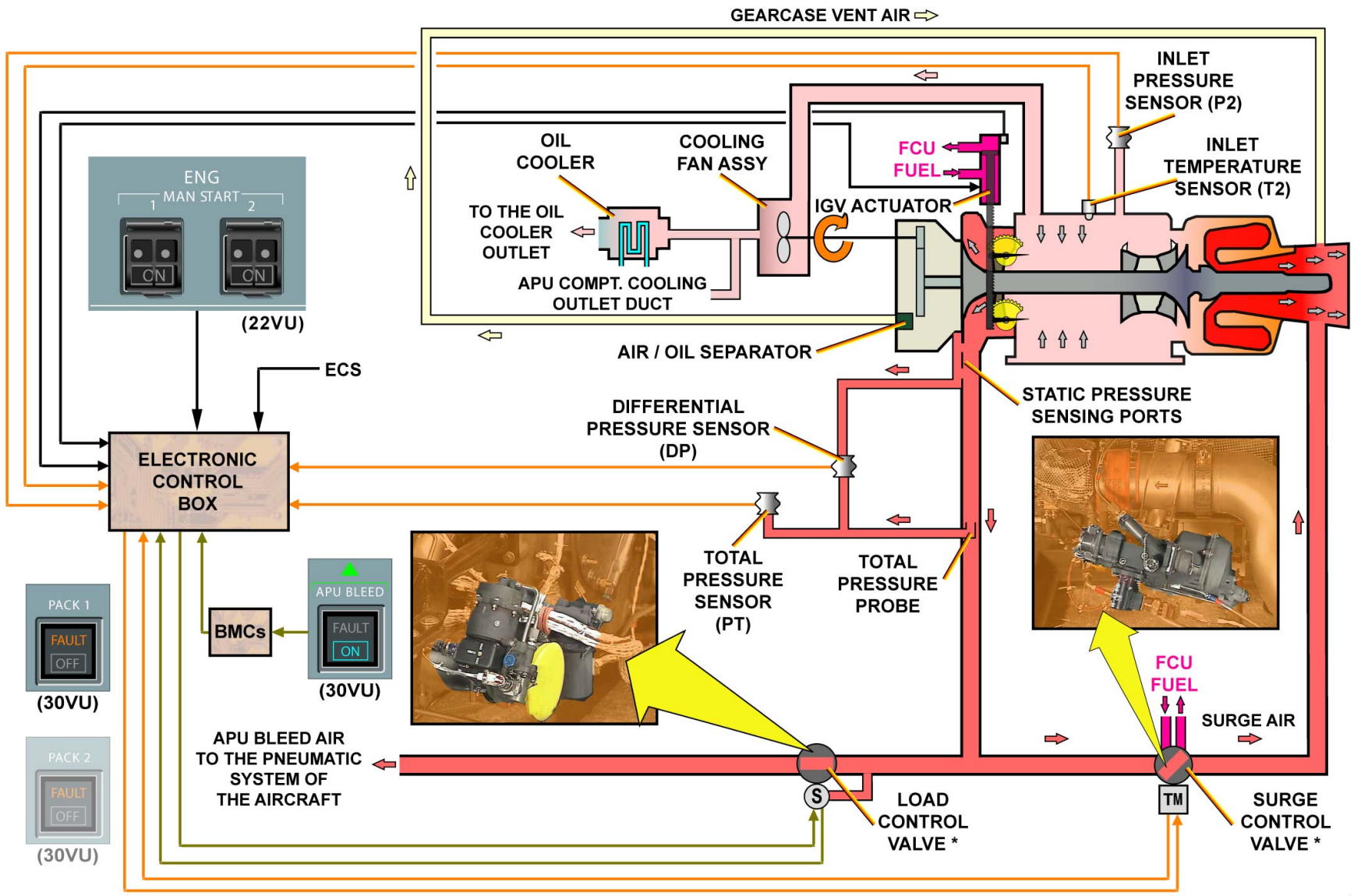

APU RUNNING AT 99% - BLEED PUSH BUTTON ON

APU AIR SYSTEM D/O (3)

APU RUNNING AT 99% (continued)

BLEED AND PACK P/B PRESSED

The ECB receives a demand signal from the ECS Control Computer after the Pack P/B on the Cockpit overhead panel is pushed in.
The ECB, due to this input signal, sends a retract command signal to the IGV-Actuator to drive the Inlet Guide Vanes into a more open position.
This will let more air from the APU Inlet Plenum go through the IGVs into the Load Compressor Housing.
To make sure the necessary bleed air mass flows from the APU to the ECS, the ECB commands the SCV to the fully closed position.

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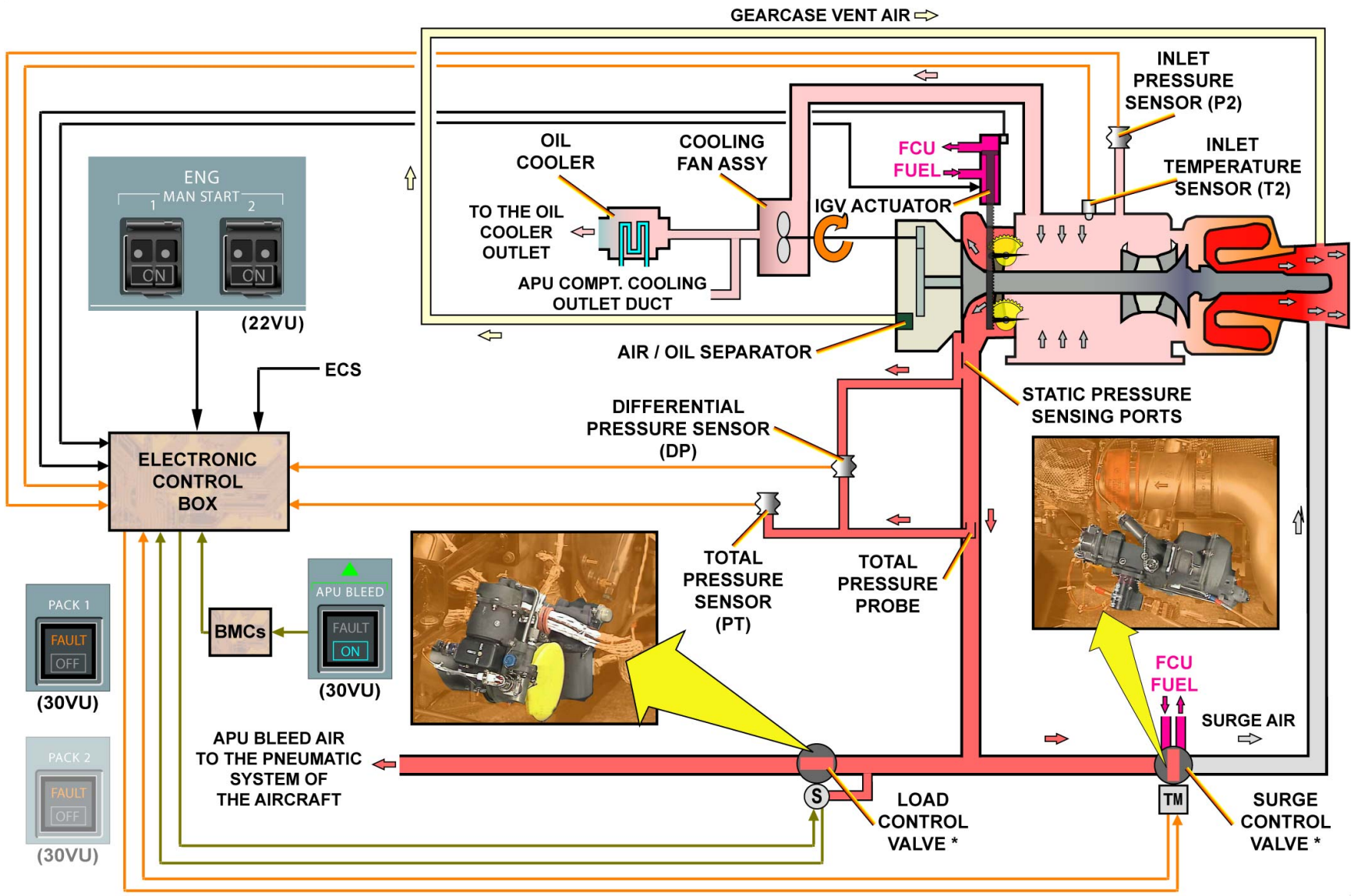

APU RUNNING AT 99% - BLEED AND PACK P/B PRESSED

APU AIR SYSTEM D/O (3)

APU RUNNING AT 100%

After the Engine Master Switch is moved to the ON position, the ECB receives a Main Engine Start (MES) boost signal to increase the bleed pressure for engine start.
The ECB commands the IGV Actuator to the maximum retracted position to drive the IGVs to the fully open position.
The SCV receives the command signal from the ECB to modulate and discharge a certain mass of air into the APU exhaust.
When the engine start is completed, the MES signal is no longer valid and the ECB commands the IGV actuator and the SCV to the required position for bleed supply to the ECS.

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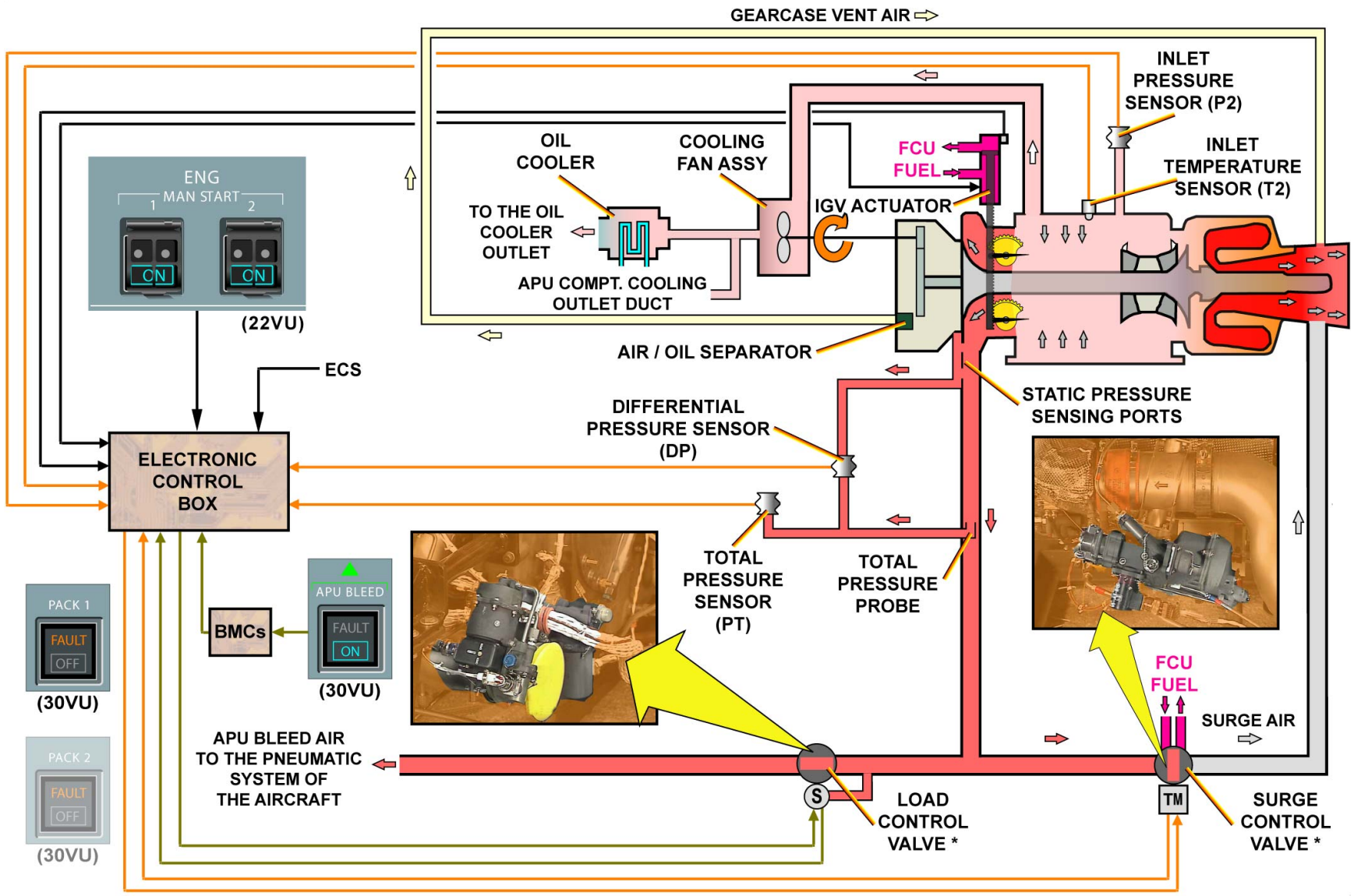

APU RUNNING AT 100%

APU SYSTEM MANAGEMENT D/O (3)

APU START SEQUENCE

Auxiliary Power Unit (APU) normal operation, starting and shutdown, are initiated from the APU control panel but controlled and monitored by the ECB.
Following conditions will be controlled and monitored:
- APU start,
- APU on-speed,
- APU normal shutdown,
- APU protective shutdown,
- APU emergency shutdown.

When the MASTER SWitch P/B is set to ON:
- the ON light comes on,
- the Electronic Control Box (ECB) is energized,
- the ECB starts the power-up test,
- the ECB exchanges data with the Data Memory Module,
- the APU LP valve opens,
- the APU fuel pump is energized if fuel system pressure is low,
- the APU air intake flap opens,
- the ECAM APU page comes into view.

When the START P/B is set to ON:
- the ON legend comes on,
- the ECB energizes the back-up start contactor and the start contactor when these conditions are present: air intake flap open, power-up test complete, data exchange between data memory module and ECB complete,
- the contactors energize the starter motor and causes the APU main shaft to start to turn,
- the igniter is energized,
- the de-oil valve opens with the oil/fuel temperature and altitude.

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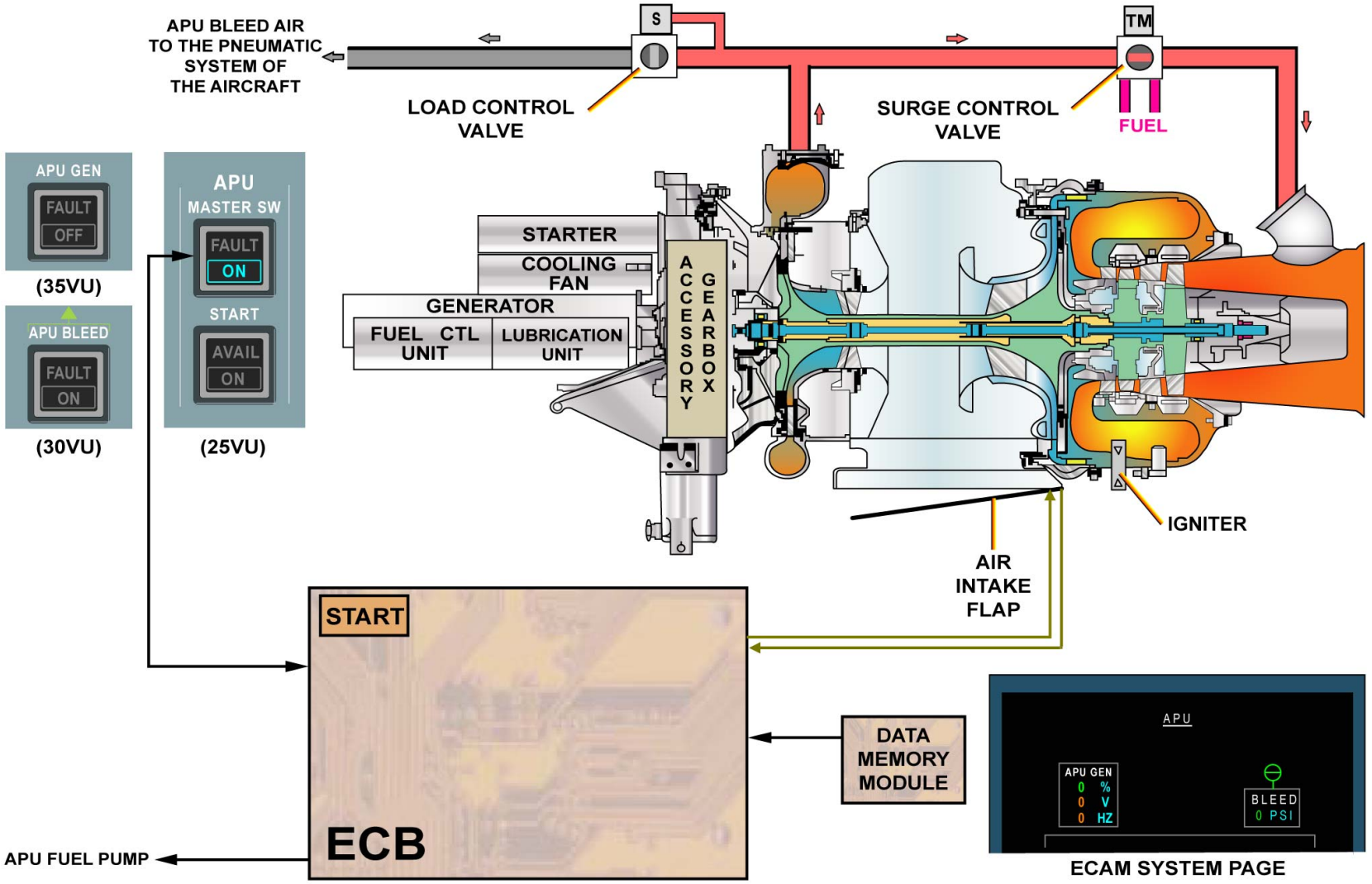
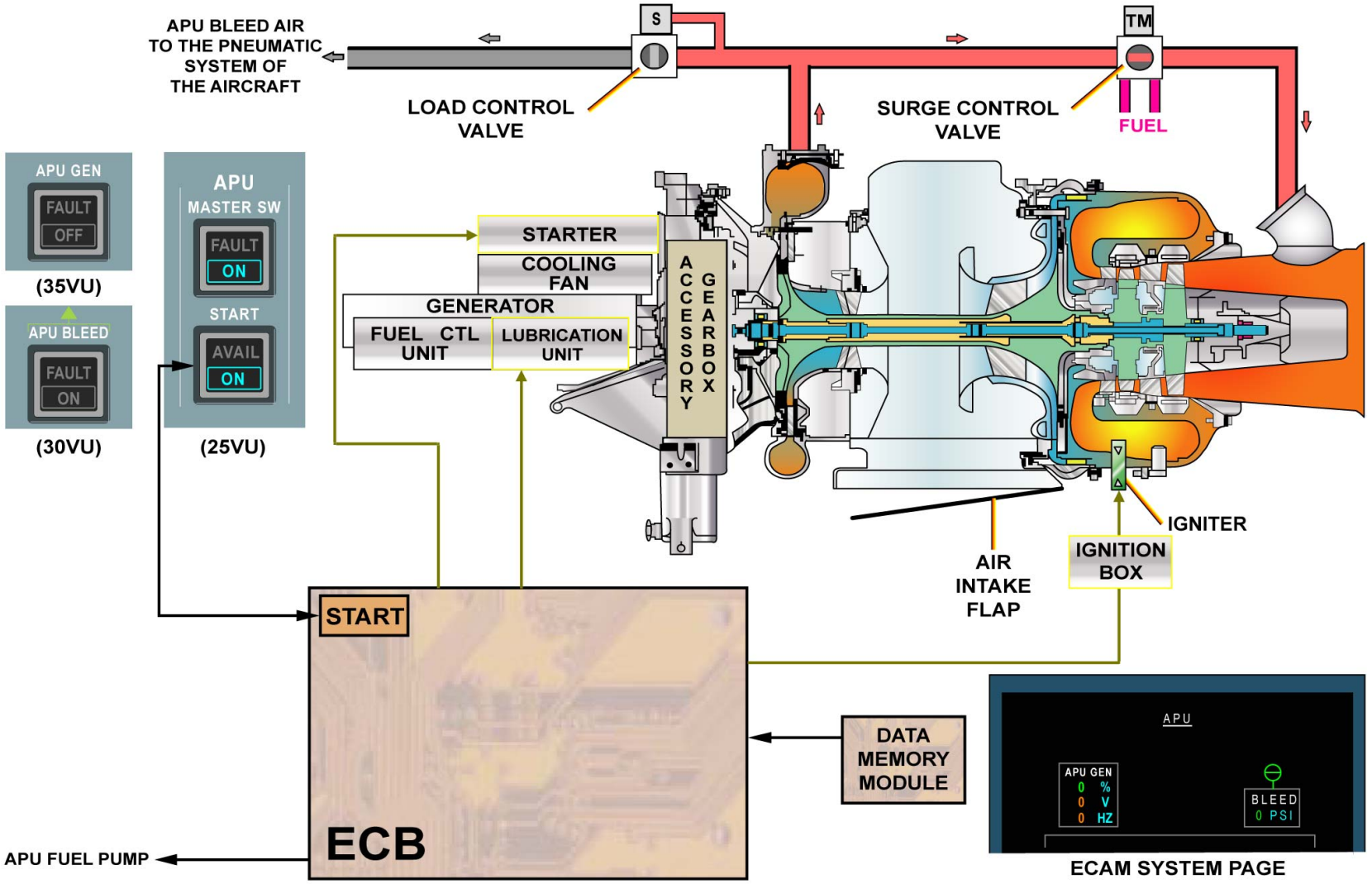


APU START SEQUENCE



APU START SEQUENCE

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APU SYSTEM MANAGEMENT D/O (3)

APU ACCELERATION SEQUENCE

APU AT 7% RPM

At 7% speed:
- the ECB opens the fuel solenoid valve and combustion occurs,
- the Inlet Guide Vanes (IGVs) close.

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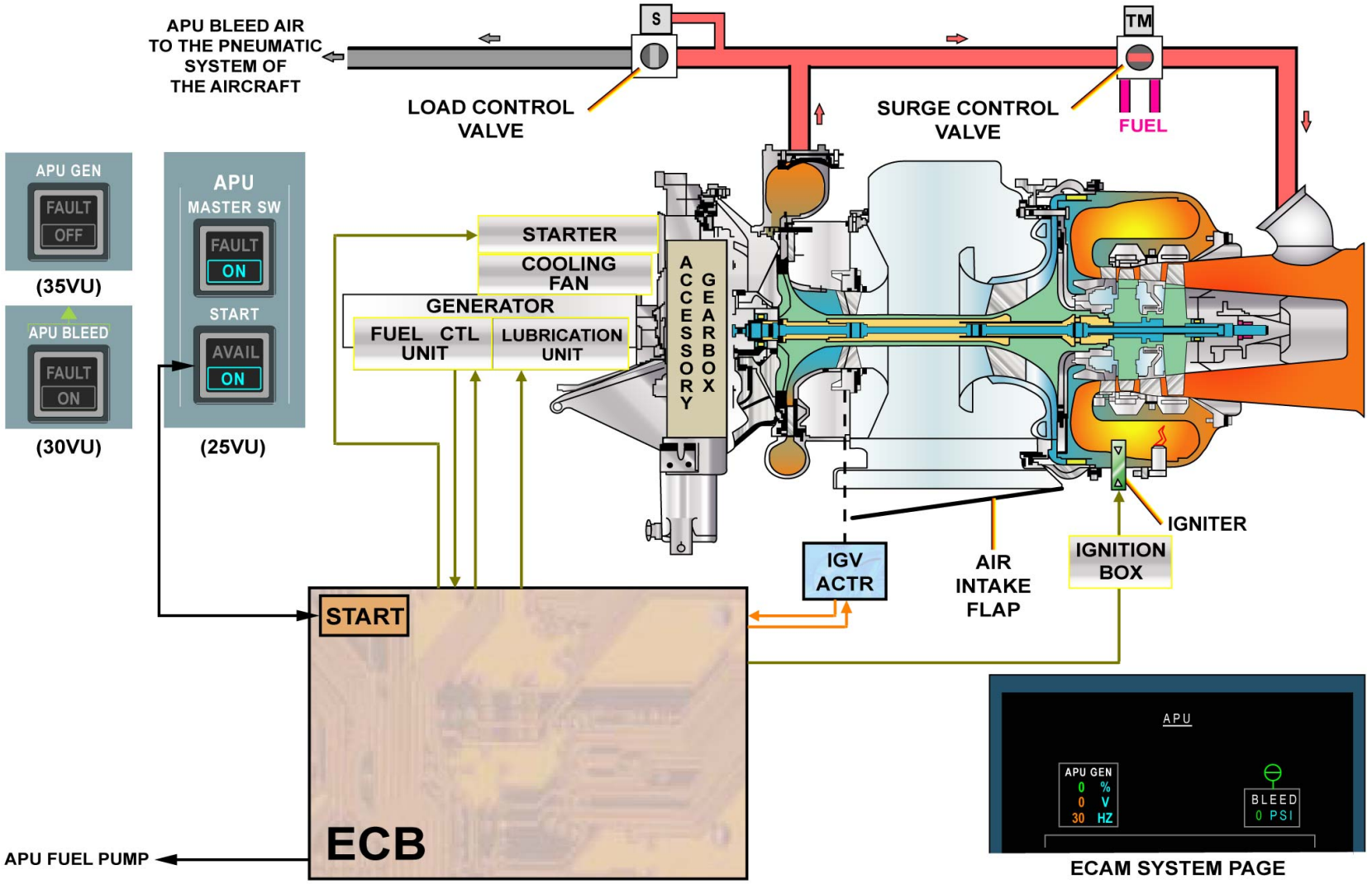

APU ACCELERATION SEQUENCE - APU AT 7% RPM

APU SYSTEM MANAGEMENT D/O (3)

APU ACCELERATION SEQUENCE (continued)

APU AT 50% RPM

At 50% speed:
- the ECB de-energizes the start contactor, above 20,000 ft at 58%, and causes the starter motor to stop and continues to increase the speed of the APU automatically,
- the ECB de-energizes the back-up start contactor.

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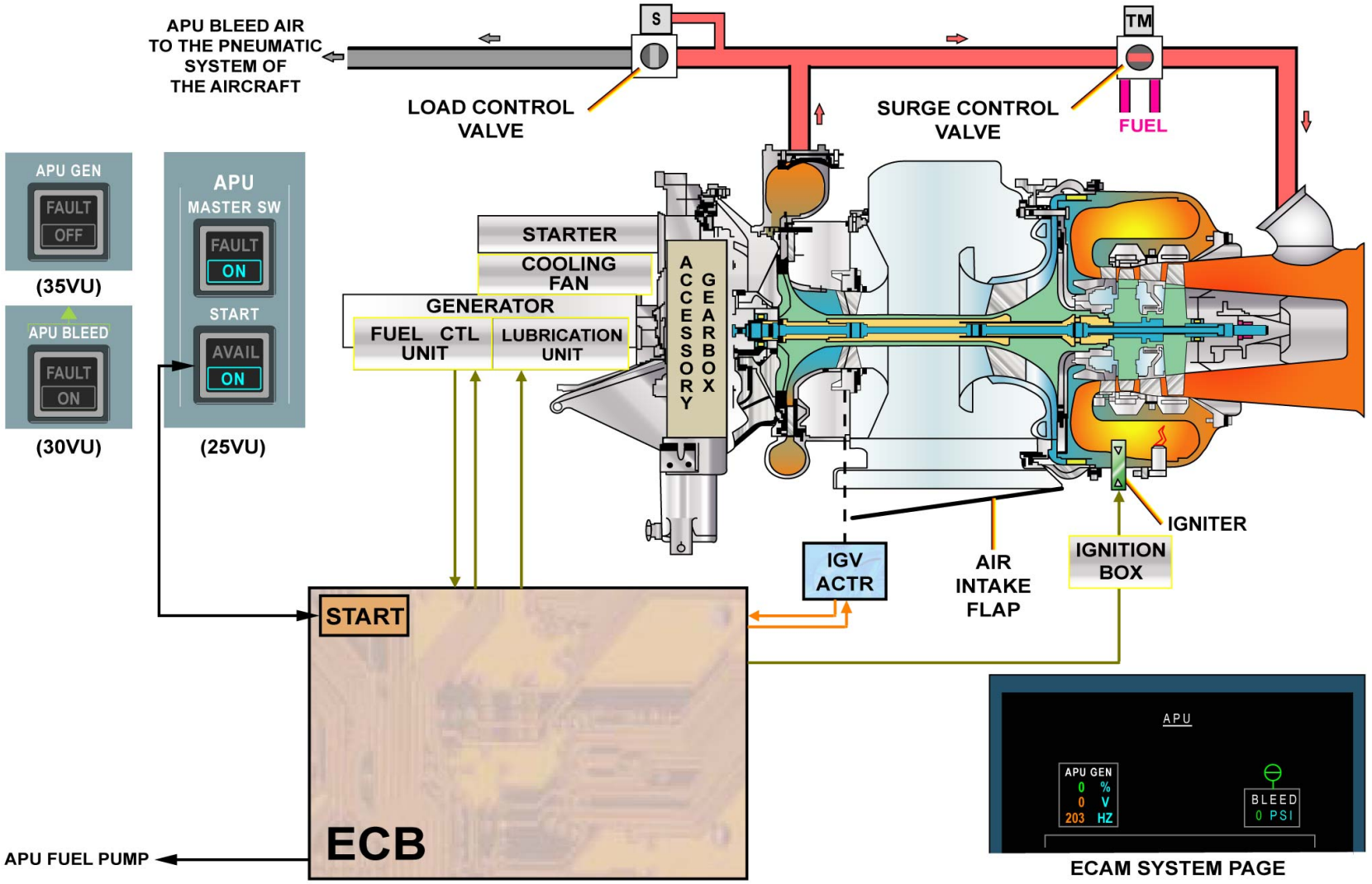

APU ACCELERATION SEQUENCE - APU AT 50% RPM

APU SYSTEM MANAGEMENT D/O (3)

APU ACCELERATION SEQUENCE (continued)

APU AT 60% RPM

At 60% speed:
- the ECB de-energizes the ignition unit,
- the ECB de-energizes the de-oil solenoid, if it is open.

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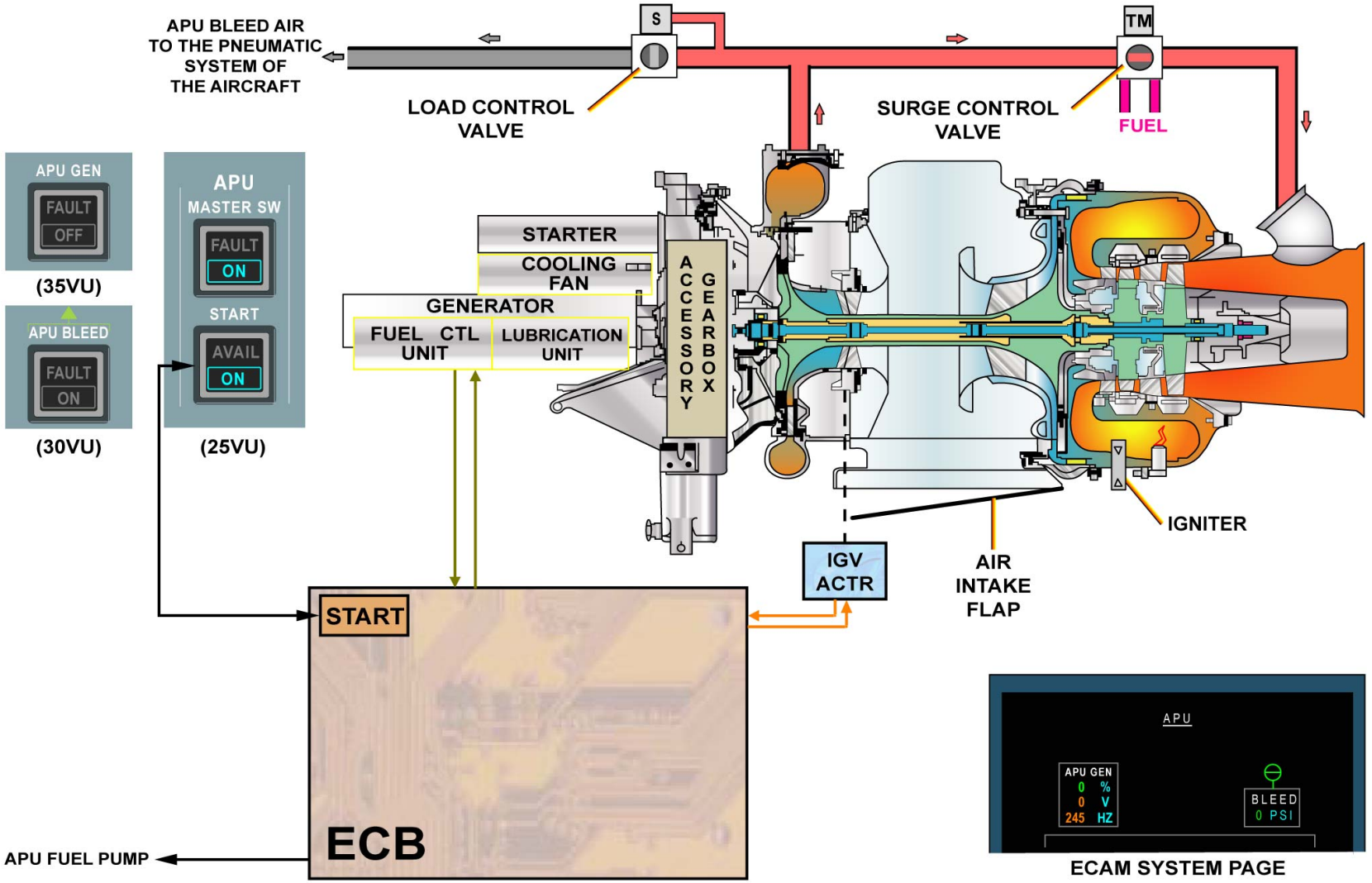


APU ACCELERATION SEQUENCE - APU AT 60% RPM

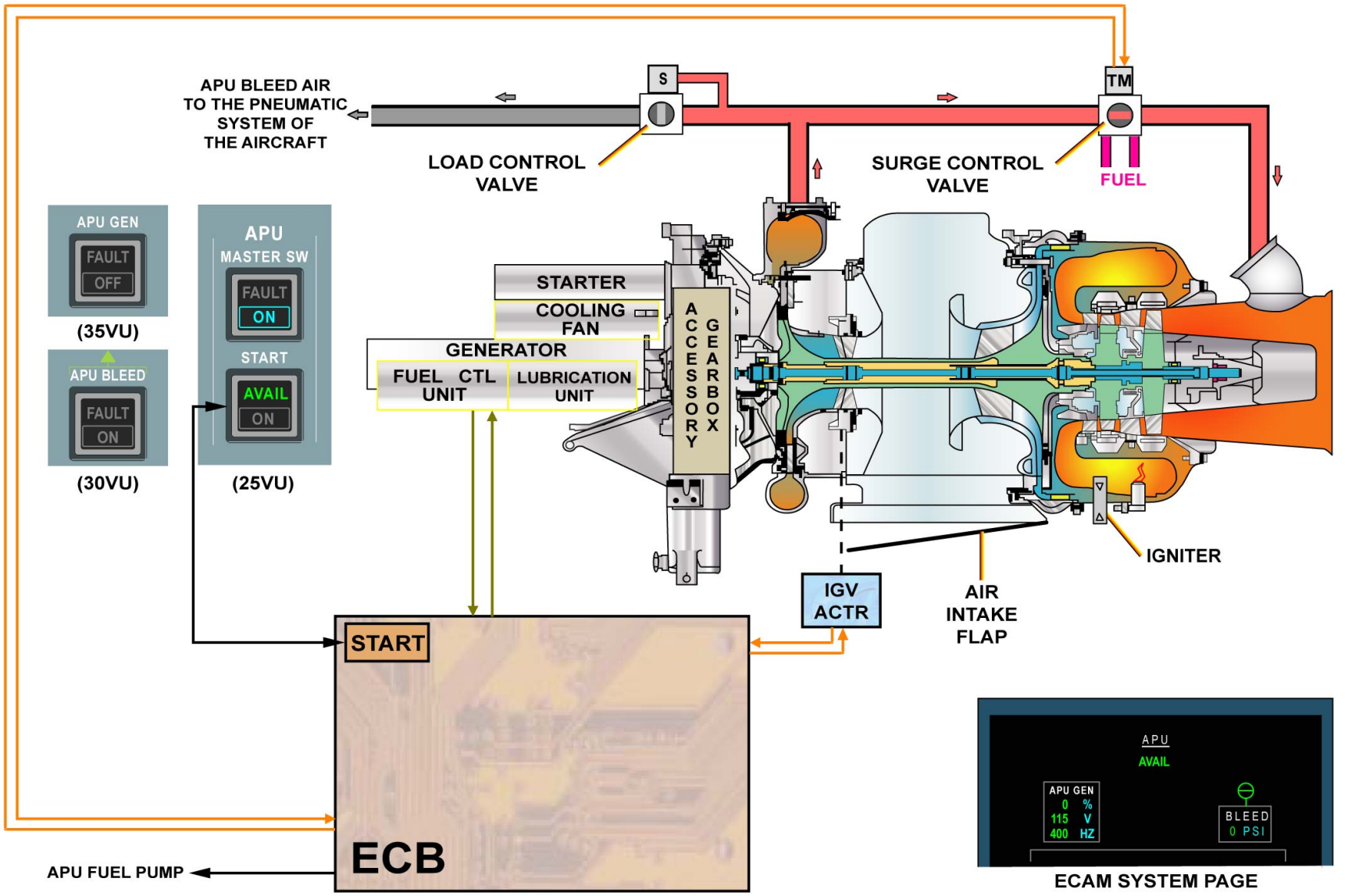
APU SYSTEM MANAGEMENT D/O (3)

APU ACCELERATION SEQUENCE (continued)

APU AT 95% RPM

At 95% speed:
- the IGVs move to 22 degrees' open position to prevent overheating,
- the ECB controls and monitors the APU automatically,
- the ON light in the START P/BSW goes off,
- the green AVAIL legend in the START P/BSW comes on,
- the APU generator can operate and APU bleed be switched to ON.

UGB13131 - U7ST0M0 - UM49D7000000001



APU ACCELERATION SEQUENCE - APU AT 95% RPM

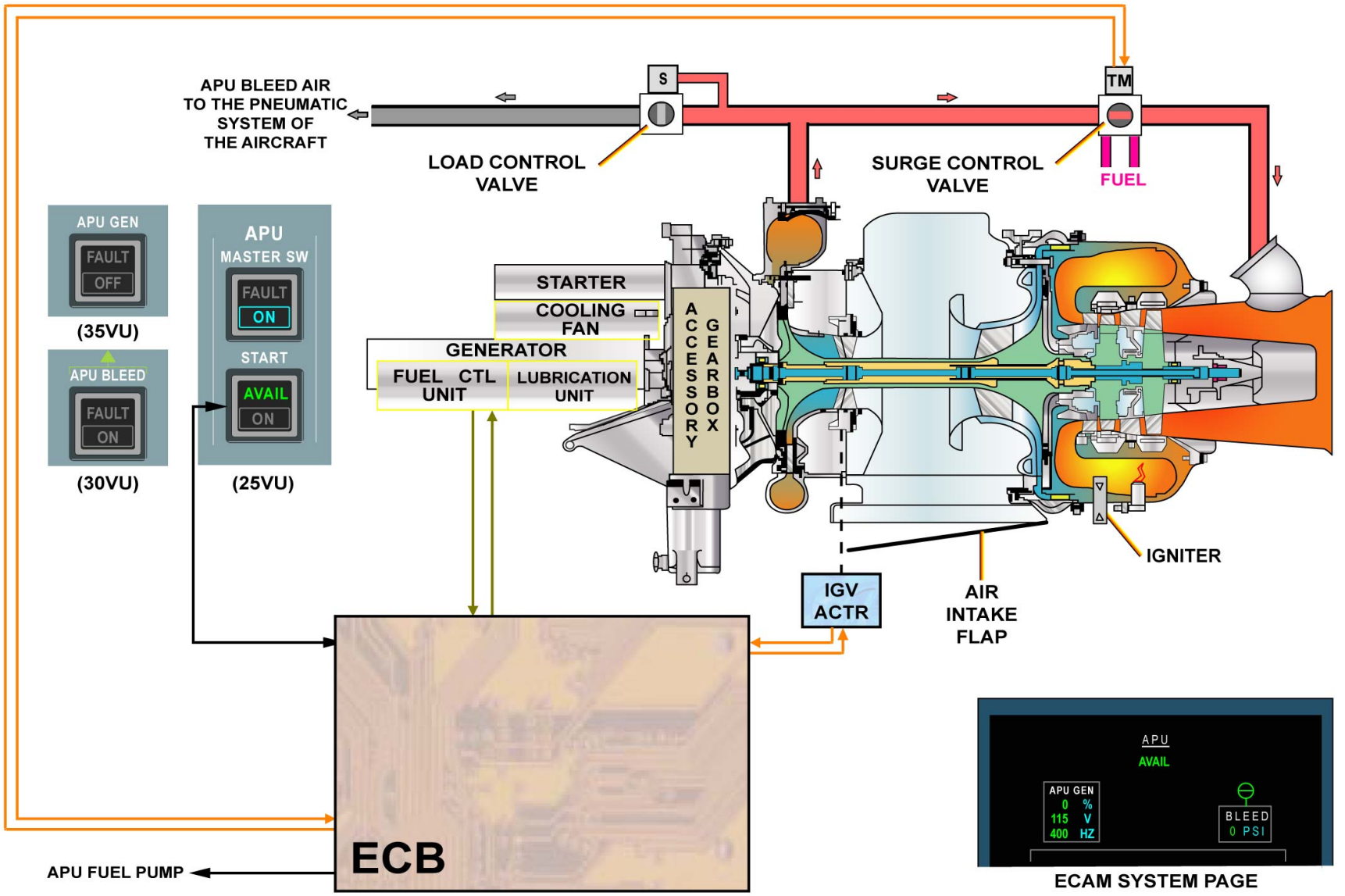
APU SYSTEM MANAGEMENT D/O (3)

APU ACCELERATION SEQUENCE (continued)

APU AT 100% RPM

At steady state speed, an on-speed governor loop controls the fuel flow to the APU. The ECB stabilizes the APU speed at 100%. However, if the APU supplies the air conditioning system on a normal day and while the aircraft is on the ground the speed is reduced to 99% for fuel saving reasons.

UGB13131 - U7ST0M0 - UM49D7000000001



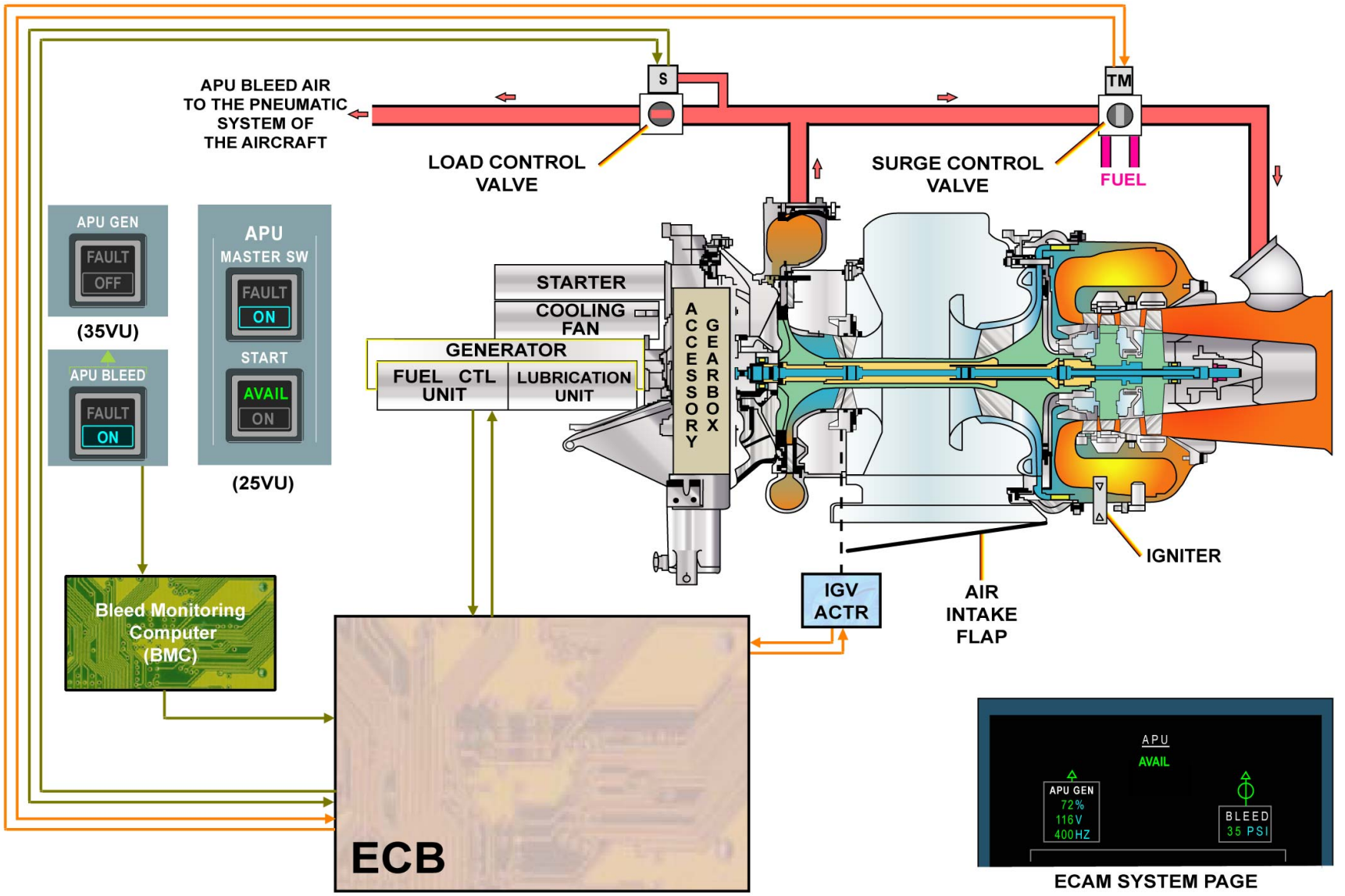
APU ACCELERATION SEQUENCE - APU AT 100% RPM

APU SYSTEM MANAGEMENT D/O (3)

APU ON-SPEED

When the APU generator operates, the generator output parameters come into view on the ECAM system page. When the APU bleed is switched to ON, bleed parameters are displayed on the ECAM system page. The ECB opens the Load Control Valve in accordance to the Bleed Monitoring Computer (BMC) signal coming from the APU Bleed P/B.

UGB13131 - U7ST0M0 - UM49D7000000001


APU BLEED AIR
TO THE PNEUMATIC
SYSTEM OF
THE AIRCRAFT
S
TM
LOAD CONTROL
VALVE
SURGE CONTROL
VALVE
FUEL
APU GEN
FAULT
OFF
(35VU)
APU BLEED
FAULT
ON
APU
MASTER SW
FAULT
ON
START
AVAIL
ON
(25VU)
STARTER
COOLING
FAN
GENERATOR
FUEL CTL
UNIT
LUBRICATION
UNIT
ACCESSORY GEARBOX
IGNITER
IGV
ACTR
AIR
INTAKE
FLAP
Bleed Monitoring
Computer
(BMC)
ECB
APU
AVAIL
APU GEN
72%
116V
400HZ
BLEED
35 PSI
ECAM SYSTEM PAGE

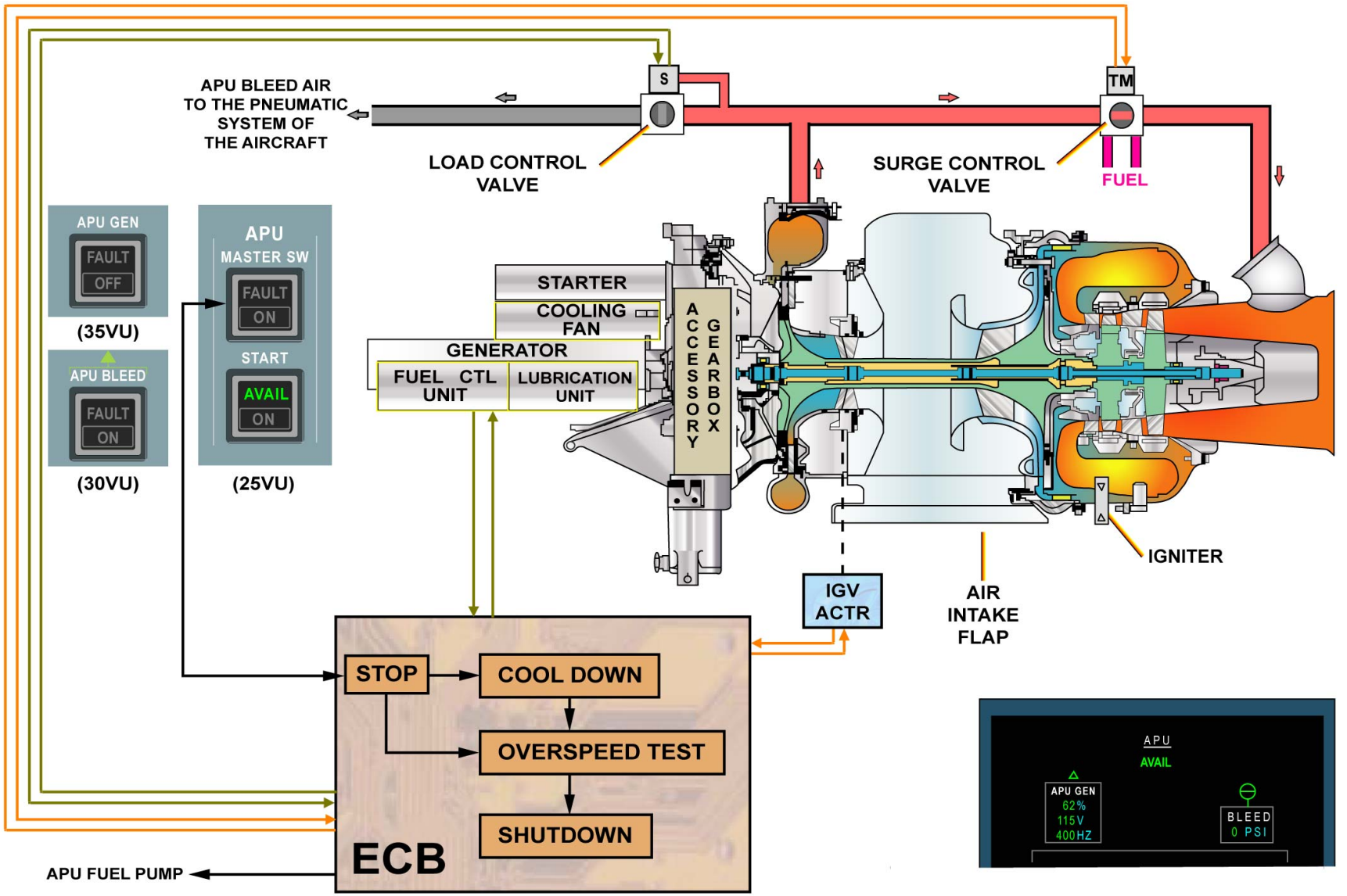
APU ON-SPEED

APU SYSTEM MANAGEMENT D/O (3)

APU NORMAL SHUTDOWN

When the MASTER SW is OFF, the ECB closes the IGVs to the minimum position of 15°, the load control valve closes if it is open, the surge control valve opens and the cool-down cycle of the APU starts.
The cool-down cycle lets the APU operate for 60 seconds at a low stabilized temperature. It starts when the ECB receives the closed signal from the load control valve. If the load control valve was not in the open position, the APU shuts down immediately.
During every normal shutdown the ECB tests its overspeed protection circuit by simulating an overspeed condition, which causes the 3-way shut-off solenoid in the Fuel Control Unit to close, and thereby starts the APU roll-down.
It is possible to command an APU re-start during the shutdown sequence. APU speed must be below 7% before the starter motor is re-engaged.

UGB13131 - U7ST0M0 - UM49D7000000001



APU NORMAL SHUTDOWN

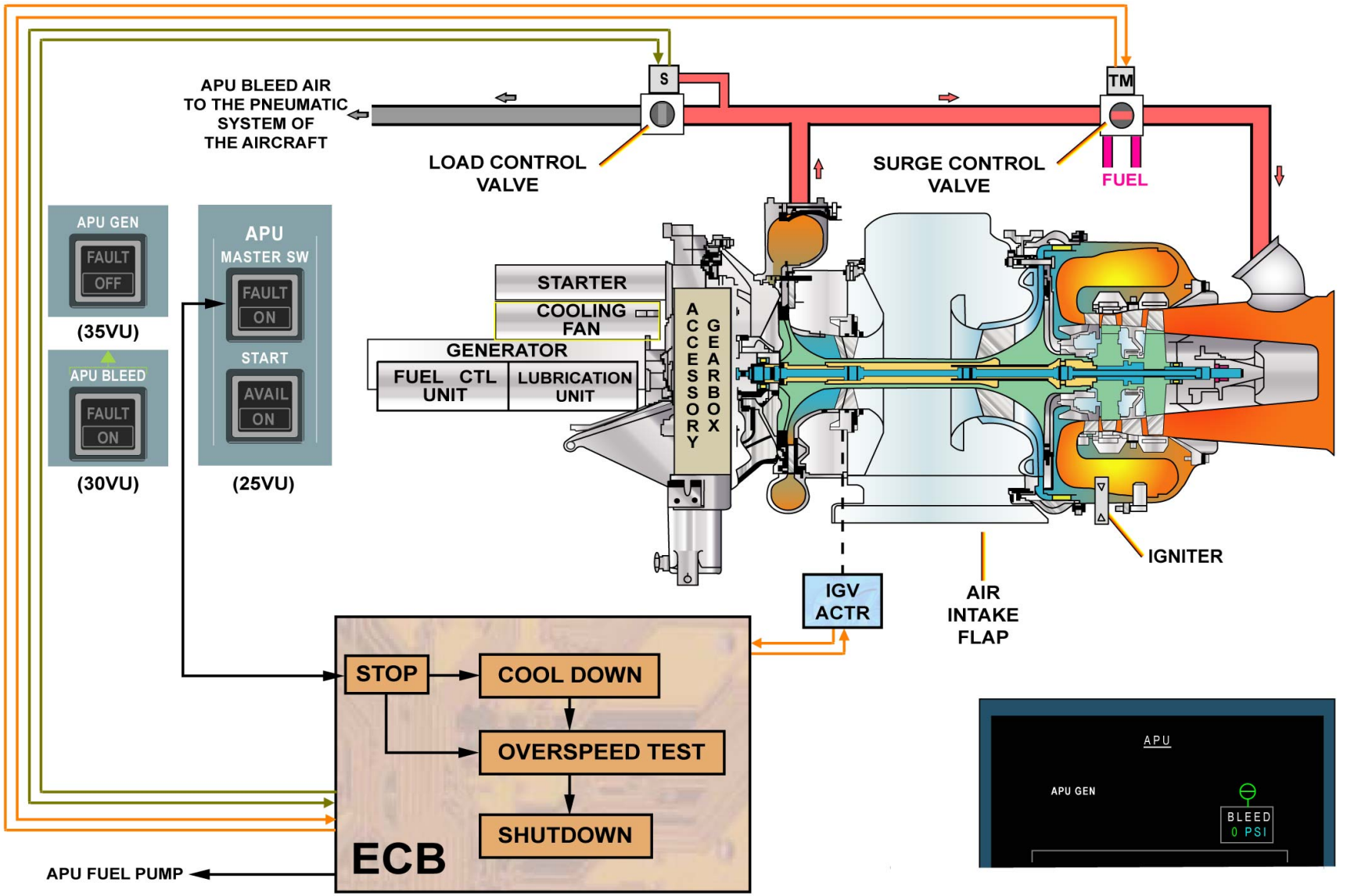
APU SYSTEM MANAGEMENT D/O (3)

APU NORMAL SHUTDOWN (continued)

APU AT 95% RPM

At 95% speed, APU "AVAIL" lights go off.

UGB13131 - U7ST0M0 - UM49D7000000001



APU NORMAL SHUTDOWN - APU AT 95% RPM

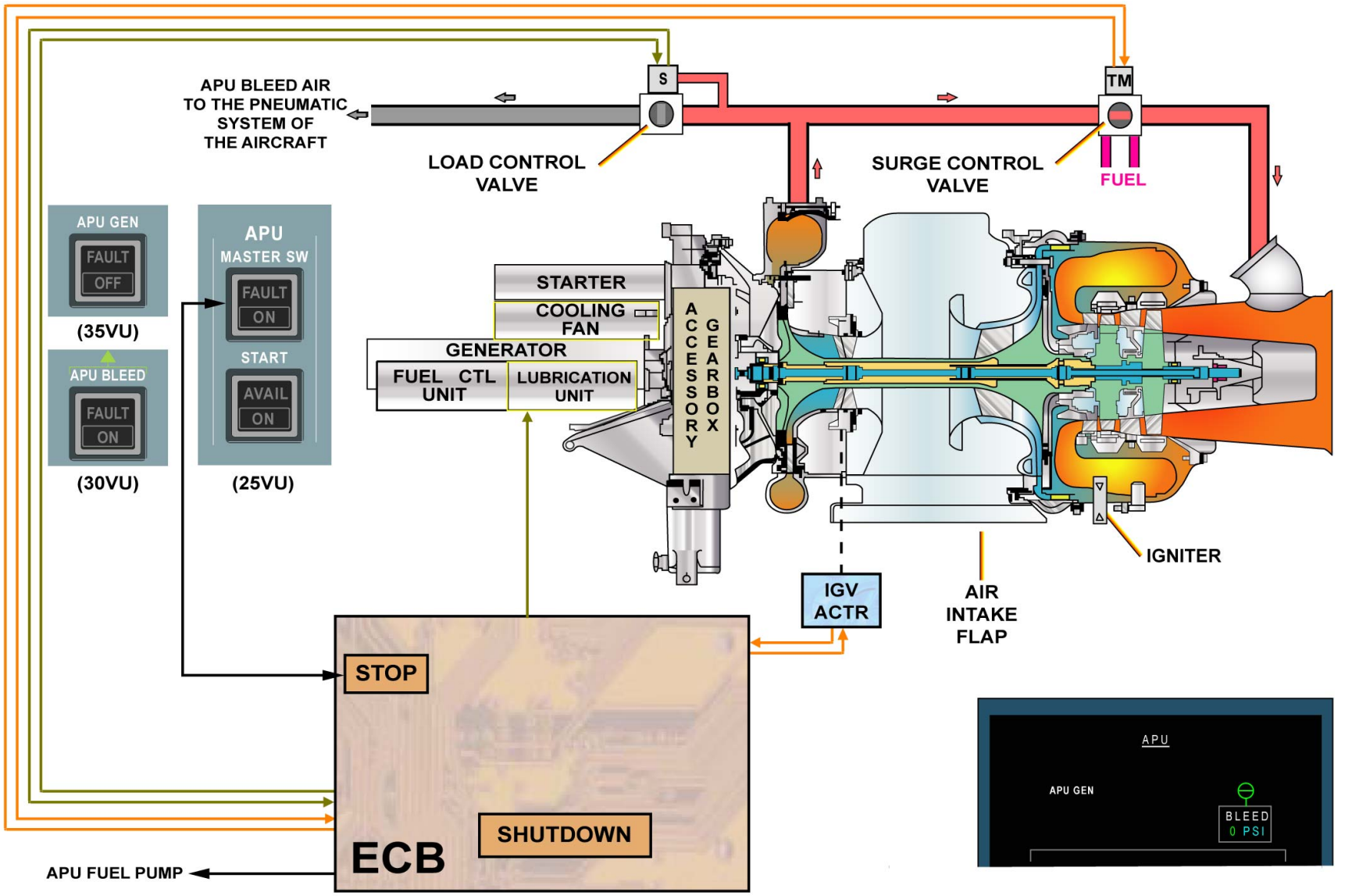
APU SYSTEM MANAGEMENT D/O (3)

APU NORMAL SHUTDOWN (continued)

APU AT 50% RPM

At 50% speed, the de-oil solenoid valve opens to decrease drag during the next start.

UGB13131 - U7ST0M0 - UM49D7000000001



APU NORMAL SHUTDOWN - APU AT 50% RPM

APU SYSTEM MANAGEMENT D/O (3)

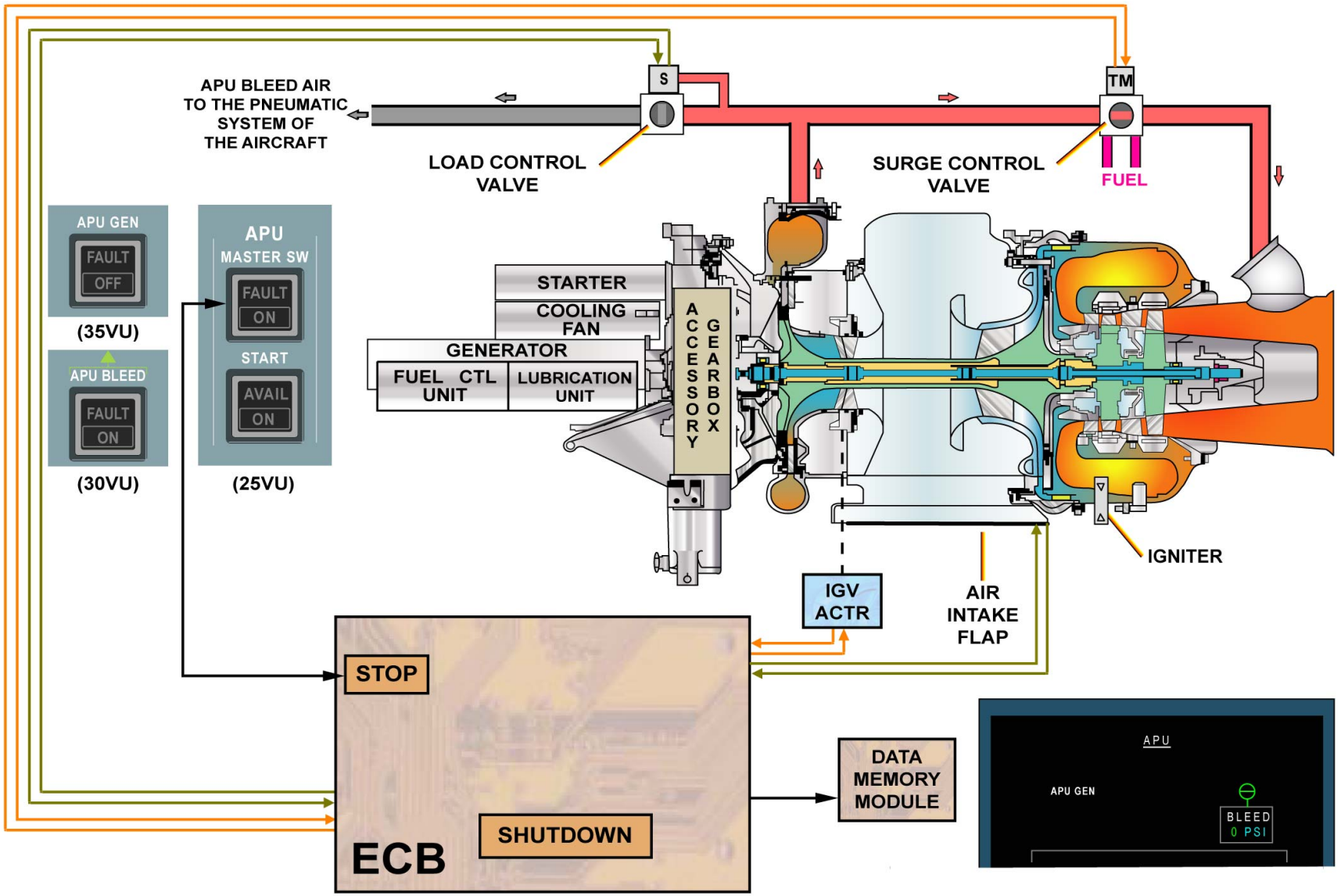
APU NORMAL SHUTDOWN (continued)

APU BELOW 7% RPM

At and below 7% speed:
- the de-oil solenoid closes,
- the APU fuel LP valve closes,
- the data memory module is updated,
- the air intake closes.

The ECB de-energizes itself when the air intake has reached the fully closed position.

UGB13131 - U7ST0M0 - UM49D7000000001



APU NORMAL SHUTDOWN - APU BELOW 7% RPM

APU SYSTEM MANAGEMENT D/O (3)

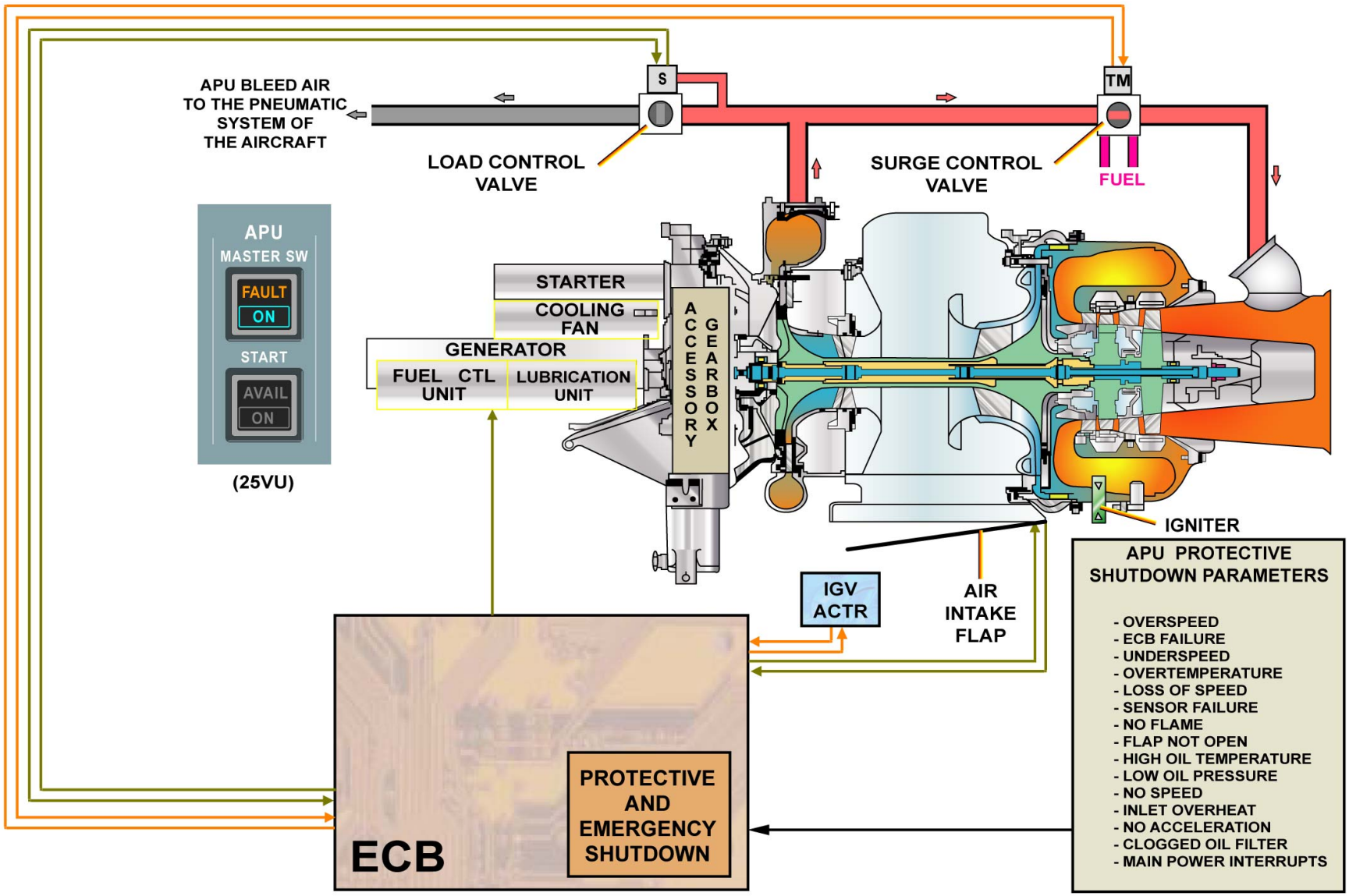
APU PROTECTIVE SHUTDOWN

When the ECB is energized, it controls the APU starting and operating phases. If an abnormal parameter is found, it starts an immediate shutdown without time delay, even if the APU bleed air is in use.
The ECB protective shutdown parameters are:
- overspeed,
- ECB failure,
- underspeed,
- overtemperature,
- loss of speed,
- sensor failure: thermocouples, low oil level and Low Oil Pressure (LOP) switch failure,
- no flame,
- flap not open,
- High Oil Temperature (HOT),
- LOP,
- no speed,
- inlet overheat,
- no acceleration,
- clogged oil filter,
- main power stop.

APU EMERGENCY SHUTDOWN

The ECB starts an emergency shutdown when the APU FIRE P/B, in the cockpit, is released out or when the APU SHUT OFF P/B, on the external power receptacle panel, is pushed. The ECB starts an automatic emergency shutdown when an APU fire is found on ground. The APU stops immediately without time delay, even if the APU bleed air system is in use.

UGB13131 - U7ST0M0 - UM49D7000000001



APU PROTECTIVE SHUTDOWN & APU EMERGENCY SHUTDOWN

ECB INTERFACES (3)

POWER SUPPLY

One of the A/C batteries at the minimum and the A/C DC network, electrically supply the Electronic Control Box (ECB), through the MAIN control relay of the Auxiliary Power Unit (APU).

MASTER SWITCH P/B

The APU MASTER SWITCH sends a discrete supply or stop signal to the ECB. The ECB sends a discrete signal to the FAULT light, when an automatic shutdown occurs or if there is an emergency shutdown.

AIR INTAKE FLAP

The ECB receives an air intake flap open or closed position signal and sends a power output to open or close the air intake flap.

START P/B

A discrete input signal from the START P/B starts the starting sequences. The ECB sends a discrete signal to the ON light during the APU start sequence. A discrete output signal to the A/C energizes the AVAIL light in the START P/B when the APU speed is above 95%.

BACK-UP AND MAIN START CONTACTORS

The ECB receives a discrete input from the main start contactor and sends discrete outputs to the back-up and main start contactors.

EMERGENCY STOP

A discrete input signal from the A/C starts the APU emergency shutdown logic after the ECB receives this signal.

LGCIU 1

The ECB receives the aircraft on ground discrete input signal from Landing Gear Control and Interface Unit (LGCIU) 1.

APU FUEL FEED SYSTEM

The ECB receives a discrete signal from the APU low fuel pressure switch. It sends a discrete signal to the APU fuel LP shut-off valve.

EIU

During engine starts, the ECB receives a Main Engine Start (MES) signal from Engine Interface Unit (EIU) 1 or 2. This signal causes the ECB to set the Inlet Guide Vanes (IGVs) to the fully open position if APU bleed has been selected to ON.

BMC

When the APU BLEED P/B is set to ON, Bleed Monitoring Computer (BMC) 1 or 2 sends a discrete input to the ECB. This controls the APU load control valve to open. The BMCs receive a closed-position signal from the APU load control valve to monitor the pneumatic system and to show ECAM indications.

TSO/JAR

The ECB receives a discrete input from the TSO/JAR configuration-programming pin. This open or ground signal finds if the ECB obeys the Technical Standard Order (TSO) or the Joint Aviation Requirements (JAR). Concerning the JAR, all System Display (S/D) circuits are available in flight. This configuration is the standard configuration. For TSO, only emergency, overspeed and loss of speed shutdowns, are available in flight.

UGB13131 - U7ST0M0 - UM49F1000000004

ENVIRONMENTAL CONTROL SYSTEM (ECS)

The ECB receives, via an ARINC 429 bus, an input from the Air Conditioning System Controller 1 and 2 (ACSC) to control the IGVs position according to the demand. The ECB sends a discrete output to the ACSC 1 and 2 to signal that the APU bleed valve is en delivery position.

A320/A321 IDENTIFICATION

The ECB receives a discrete input from the A/C signature PIN PROGramming. This identification pin lets the ECB identify A321 applications for functional differences from those of an A320.

SDAC

The ECB sends to System Data Acquisition Concentrators (SDACs) 1 and 2, through ARINC 429 Data buses, the indications to show on the ECAM APU page and shutdown information to start the related warnings.

CFDS

The ECB is a BITE system type-1 computer and connects to the Centralized Fault Display System (CFDS) through ARINC 429 data buses.

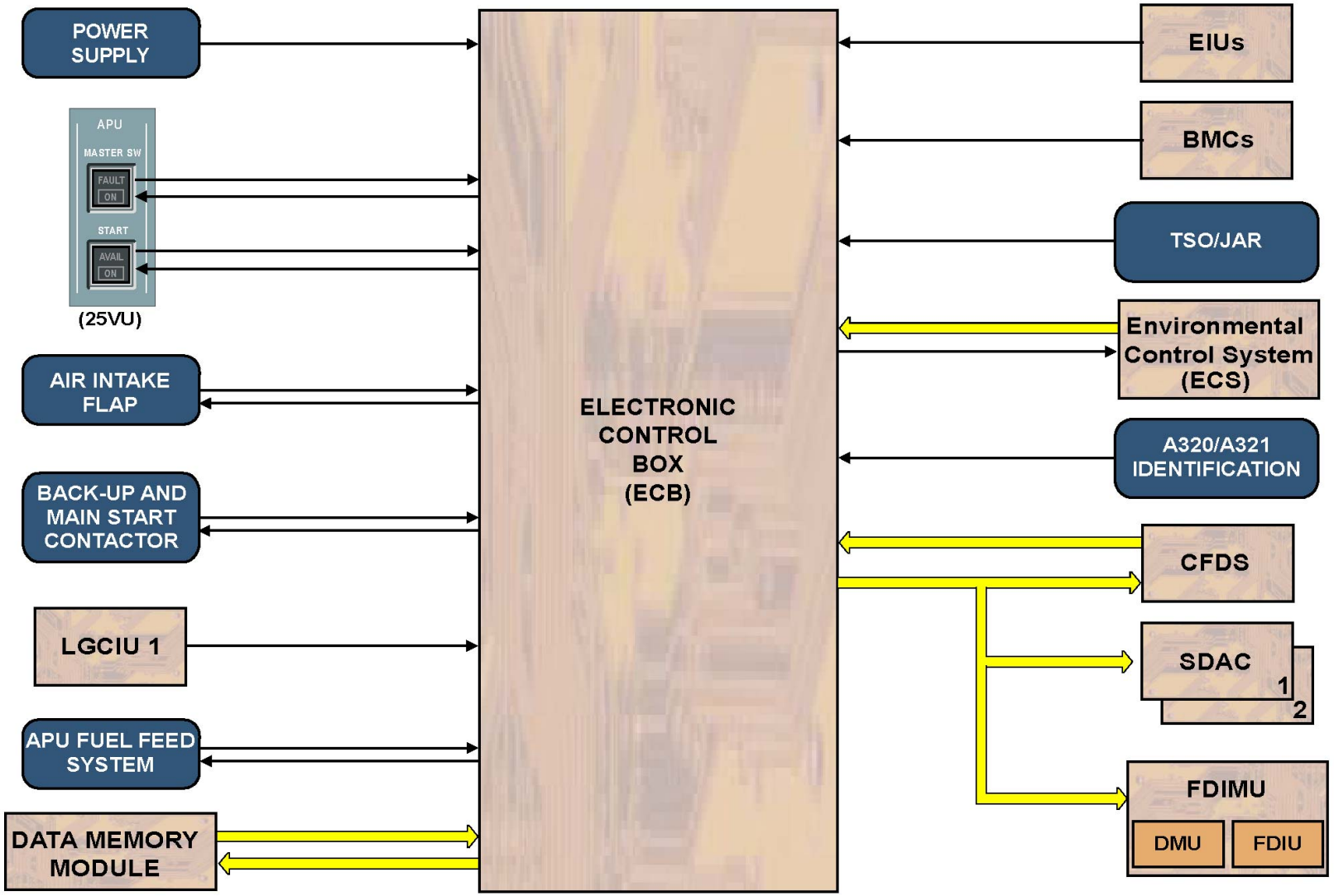
DMU PART

The Data Management Unit (DMU) part of the Flight Data Interface and Management Unit (FDIMU) partially keeps APU lifetime data. This information lets you monitor the engine conditions.

DATA MEMORY MODULE

A data memory module installed on the APU inlet plenum keeps and interchanges many parameters with the ECB:
- APU serial number,
- APU operating hours and starts,
- APU accumulated hot time,
- APU accumulated shutdowns, etc.

UGB13131 - U7ST0M0 - UM49F1000000004



POWER SUPPLY ... DATA MEMORY MODULE

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UGB13131 - U7ST0M0 - UM49F1000000004

APU DRAIN SYSTEM PRESENTATION (2)

APU DRAIN SYSTEM

A drain system prevents the collection of fluids in the Auxiliary Power Unit (APU) system and compartment.

FCU / OIL PUMP SEAL DRAIN

The Fuel Control Unit (FCU) / oil pump seal drain line is routed via a collector line to the drain tank. This line drains fuel or oil leaks.

BLEED CONTROL VALVE ACTUATOR SEAL DRAIN

The bleed control valve actuator seal drain line is routed via a collector line to the drain tank. This line drains fuel leaks only.

INLET GUIDE VANE ACTUATOR SEAL DRAIN

The Inlet Guide Vane (IGV) actuator drain line is routed via a collector line to the drain tank. This line drains fuel leaks only.

FRONT BEARING SEAL DRAIN

Any oil leak from the front bearing seal flows to the A/C drain mast.

START FUEL MANIFOLD PURGE

The fuel, which remains in the pilot injectors and manifold, is purged to the APU exhaust.

AIR BYPASS PLENUM DRAIN

The air bypass plenum drain line is routed to the drain mast. This drain line collects fuel, water or air leaks.

EXHAUST MUFFLER DRAIN

The exhaust muffler drain line is routed to the drain mast. This drain line collects fuel, water or air leaks.

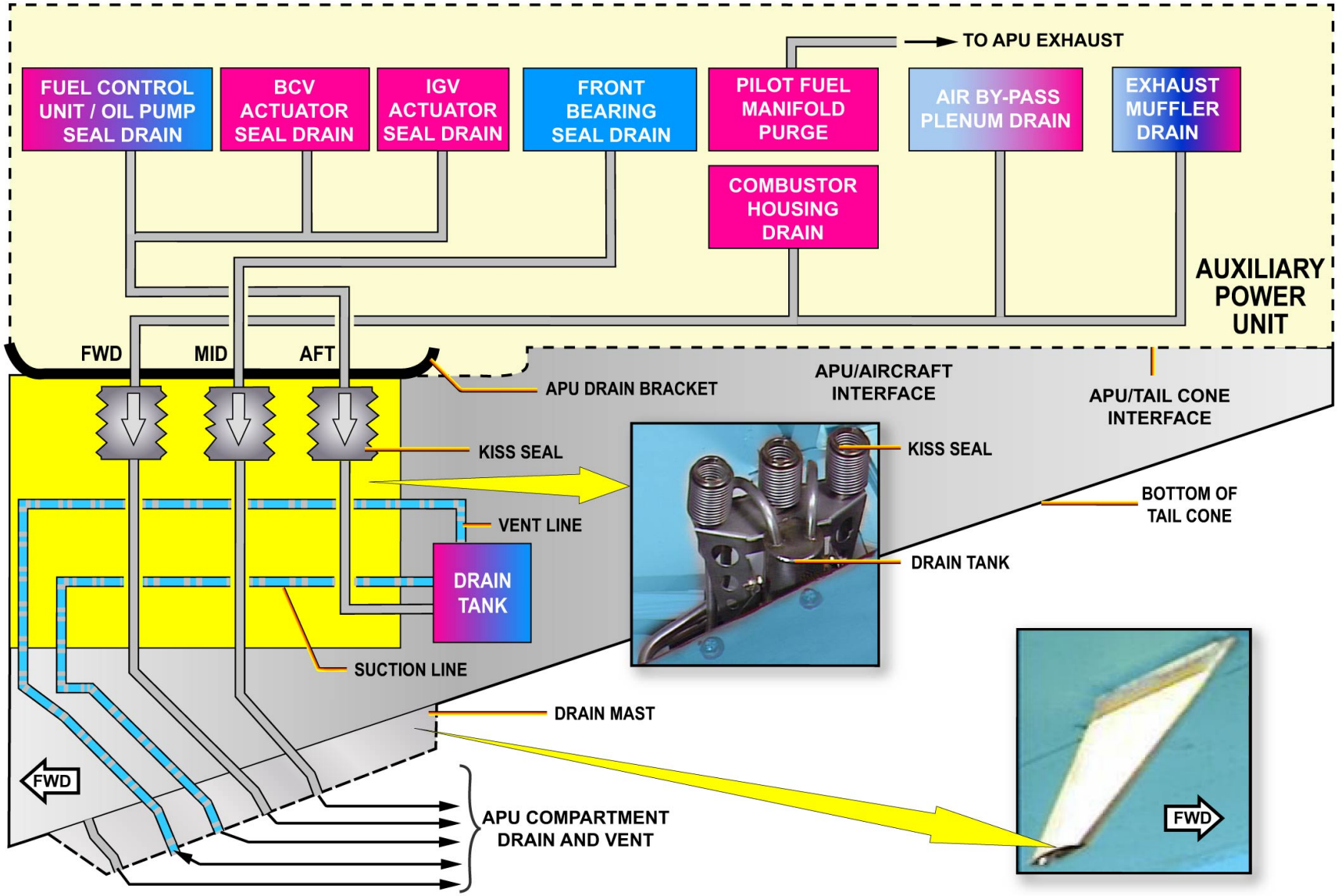
COMBUSTOR HOUSING DRAIN

The combustion housing drain line is routed to the drain mast. This drain line collects unburned fuel from the combustion chamber that may be accumulated in the combustor following an unsuccessful light-up.

DRAIN TANK

For venting and evacuation the drain tank is connected to the drain mast. Airflow across the drain mast creates a vacuum in the drain line. The suction effect produced at 200 kts, is sufficient to remove the contents of the drain tank. A vent line ventilates the drain tank and drain lines. The APU drain lines are connected to the right access door drain lines through spring adapter kiss seals.

UGB13131 - U7ST0M0 - UM49P2000000003



APU DRAIN SYSTEM ... DRAIN TANK

APU BASIC DESCRIPTION (3)

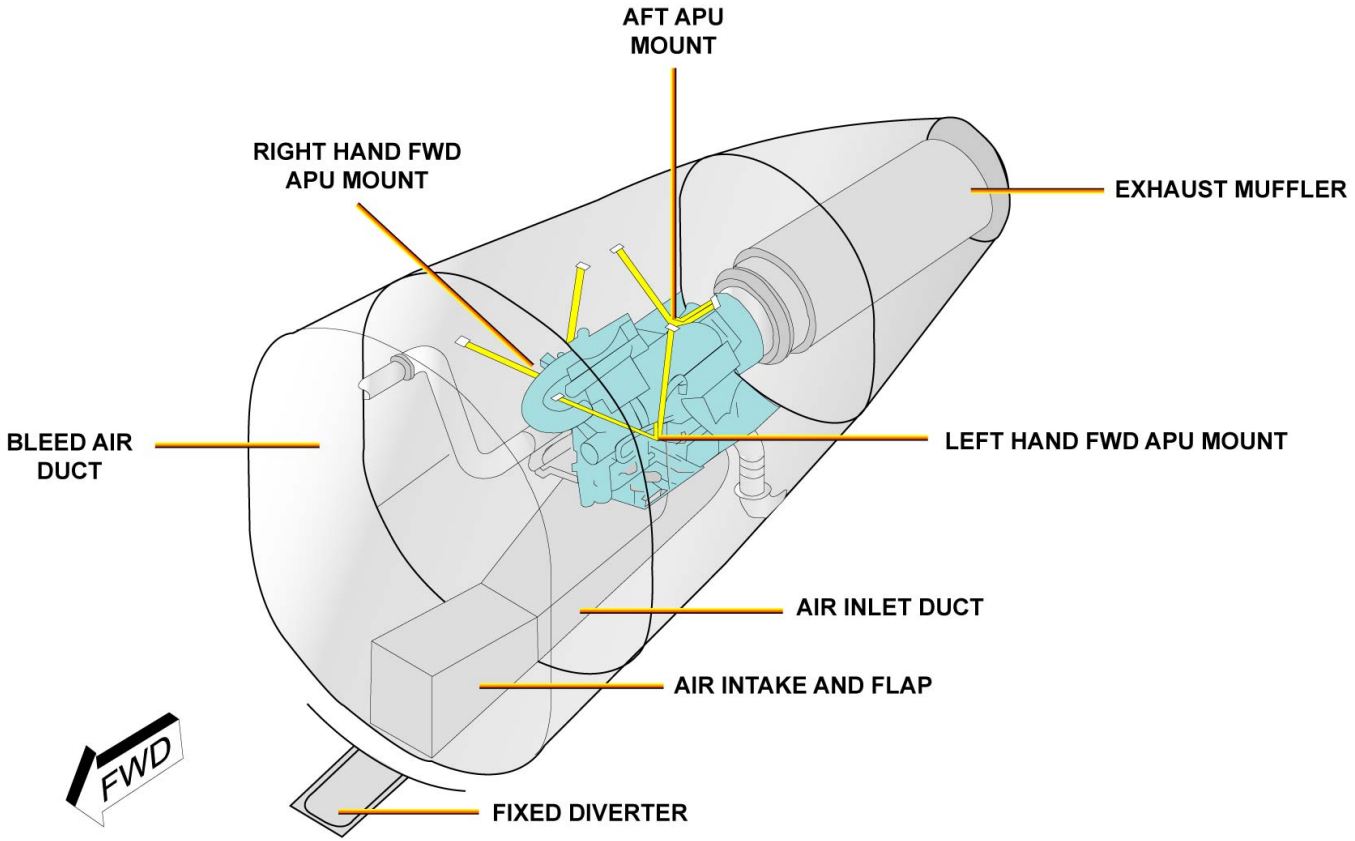
GENERAL

The Auxiliary Power Unit (APU) is installed in the fuselage tail cone. Tie rods attach the unit by a three-point mounted suspension system to the structure brackets on the compartment ceiling in a fireproof compartment. A pair of access doors on the bottom of the tail cone opens outwards to let the APU be lifted and lowered.

AIR INTAKE SYSTEM

The air intake system ducts ambient air to the APU inlet plenum. The air intake system includes:
- a fixed diverter that increases ram air recovery for flight operation and also prevents any fluids, flowing along the fuselage, from entering the air intake,
- an air intake with inlet flap,
- an air inlet duct.

UGB13131 - U7ST0M0 - UM49D1000000003



GENERAL & AIR INTAKE SYSTEM

APU BASIC DESCRIPTION (3)

ENGINE CONTROLS

The Electronic Control Box (ECB) controls and monitors the APU operation. It is a Full Authority Digital Engine Control (FADEC) type computer. The ECB has the following functions:
- control of the APU start sequence,
- monitoring of the APU speed, exhaust gas temperature and bleed air supply,
- normal stop sequence and automatic or emergency shutdown,
- failure indication for trouble shooting.

ENGINE

The APU is a single spool engine based on a modular design including a power section, driving a single stage centrifugal load compressor and an accessory gearbox. The APU power section has:
- a single stage centrifugal compressor,
- a reverse flow combustion chamber,
- a two-stage axial flow turbine.

IGV

The Inlet Guide Vanes (IGVs) control the amount of air discharged from the APU load compressor. The 24 IGVs are moved simultaneously by a gear train operated by an actuator. The IGV system uses fuel as hydraulic fluid for the servo valve actuator to control the IGVs through the ECB.

BLEED AND SURGE AIR

The bleed and surge air system supplies air to the A/C pneumatic system while avoiding load compressor surge. The bleed control valve acts as a combined bleed and surge valve, electrically controlled by the ECB and fuel operated.

OIL SYSTEM

A wet sump lubrication system cools and lubricates the electrical generator, the accessory gearbox and the APU bearings. The system components are all located on the gearbox except the oil cooler that is located on the APU left hand side.

IGNITION AND STARTING SYSTEM

The ignition and starting system rotates the engine to a self-sustained speed. It also will start ignition of the fuel/air mixture in the engine combustion chamber. The system includes:
- an electrical starter motor,
- an ignition unit,
- two igniter plugs.

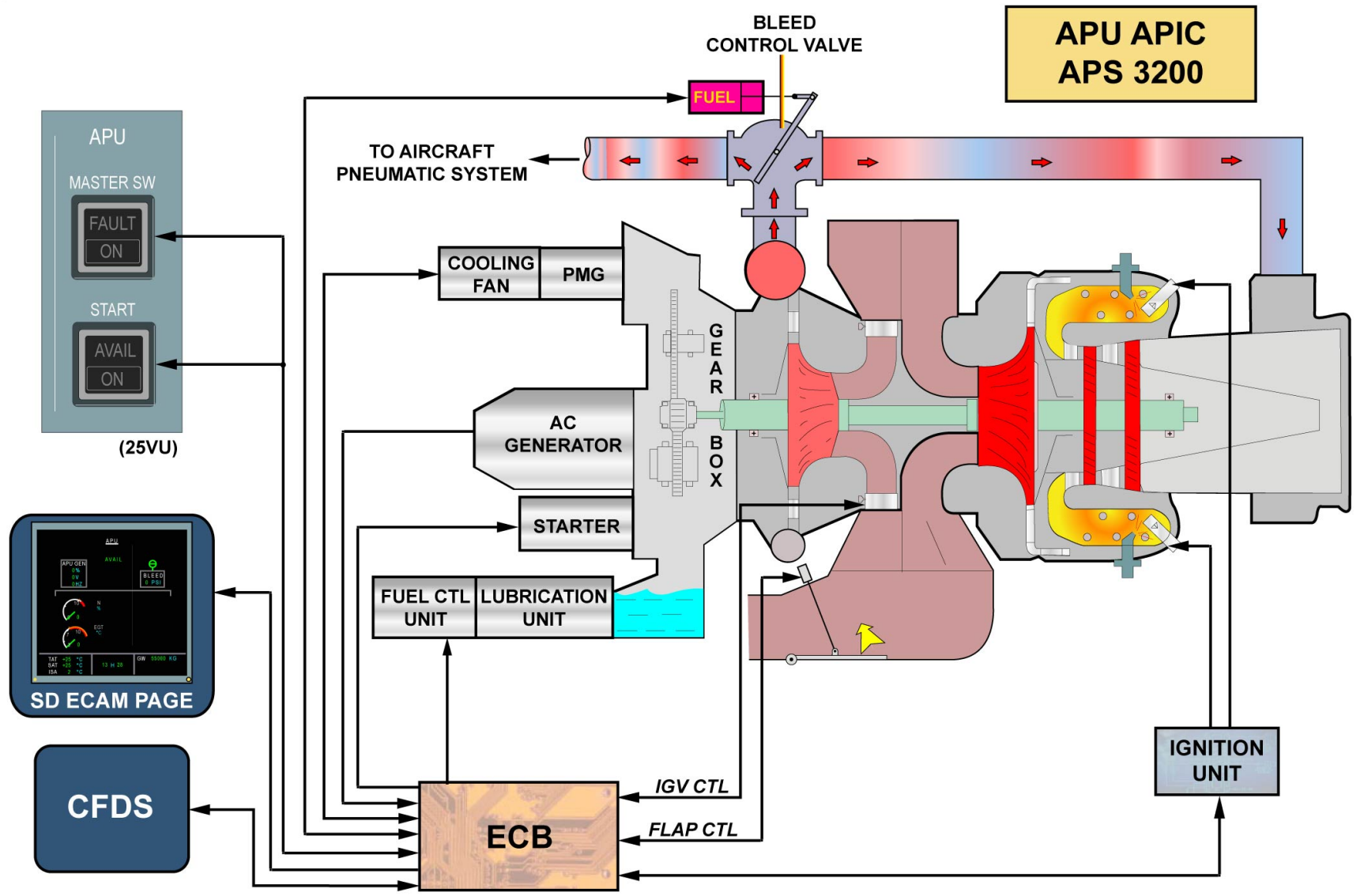
ACCESSORY GEARBOX

The gearbox transmits the shaft power to the APU accessories and to the APU generator, which are installed on the gearbox pads. The gearbox is also the oil reservoir for the APU lubrication system. The components mounted on the accessory gearbox are:
- the starter motor assembly,
- the cooling air fan assembly with the Permanent Magnet Generator (PMG),
- the Fuel Control Unit (FCU),
- the AC generator.

AC GENERATOR

The 3 phases AC generator transforms the mechanical power into electrical power of 90 KVA to supply the electrical A/C system with 115V-400Hz.

UGB13131 - U7ST0M0 - UM49D1000000003



ENGINE CONTROLS ... AC GENERATOR

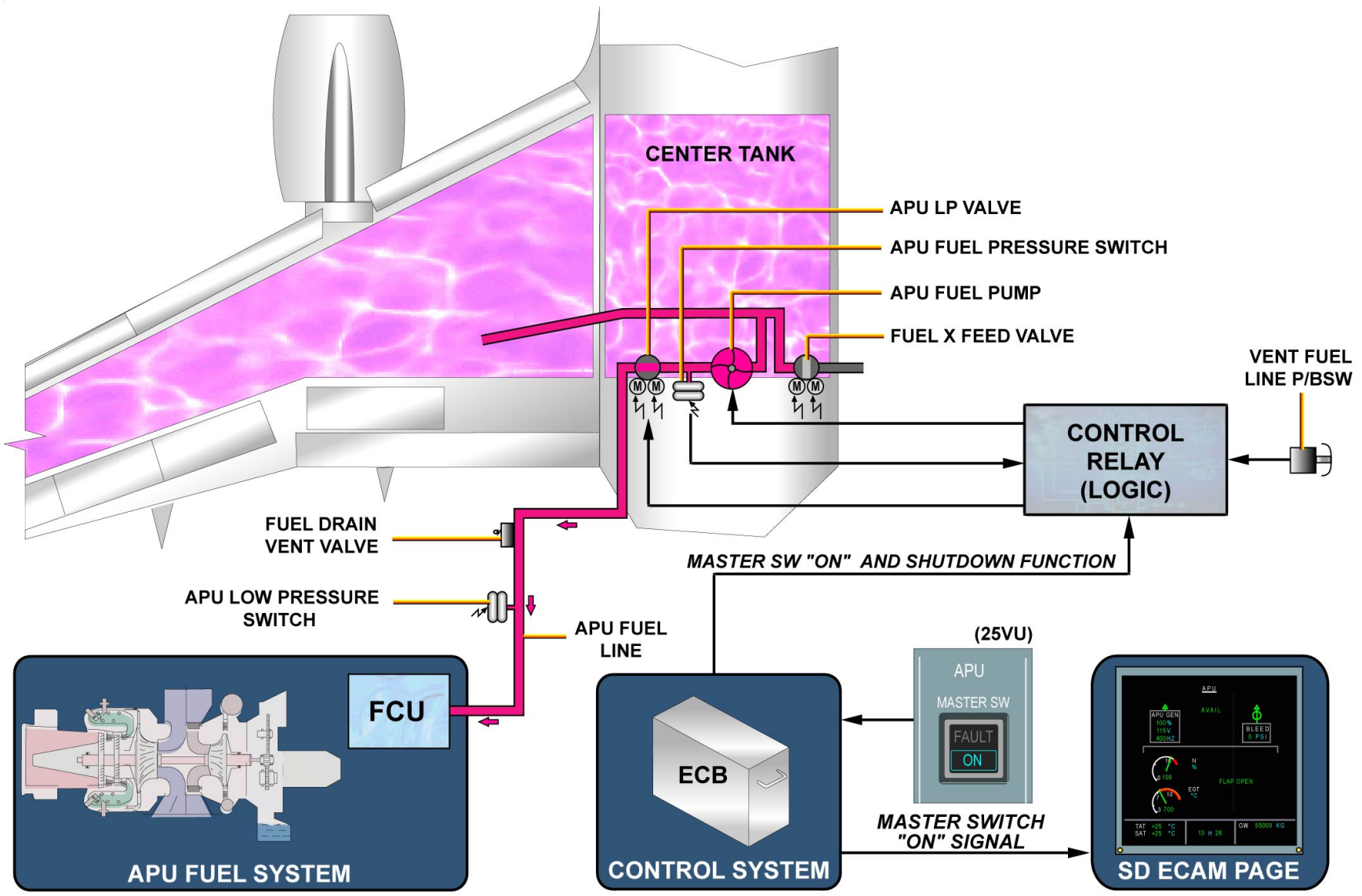
APU BASIC DESCRIPTION (3)

FUEL SYSTEM

The APU is supplied of fuel from either the fuel tank pumps or the APU fuel pump, according to the pressure sensed in the APU fuel feed line upstream of the pump. The APU fuel system operates automatically and includes:

- an APU fuel pump, an APU fuel pressure switch,
- a LP valve,
- a fuel LP switch,
- an FCU for Fuel Flow (FF) scheduling,
- a fuel line vent and drain valve.

UGB13131 - U7ST0M0 - UM49D1000000003



FUEL SYSTEM

UGB13131 - U7ST0M0 - UM49D1000000003

APU IGNITION & STARTING D/O (3)

STARTER CONTROL

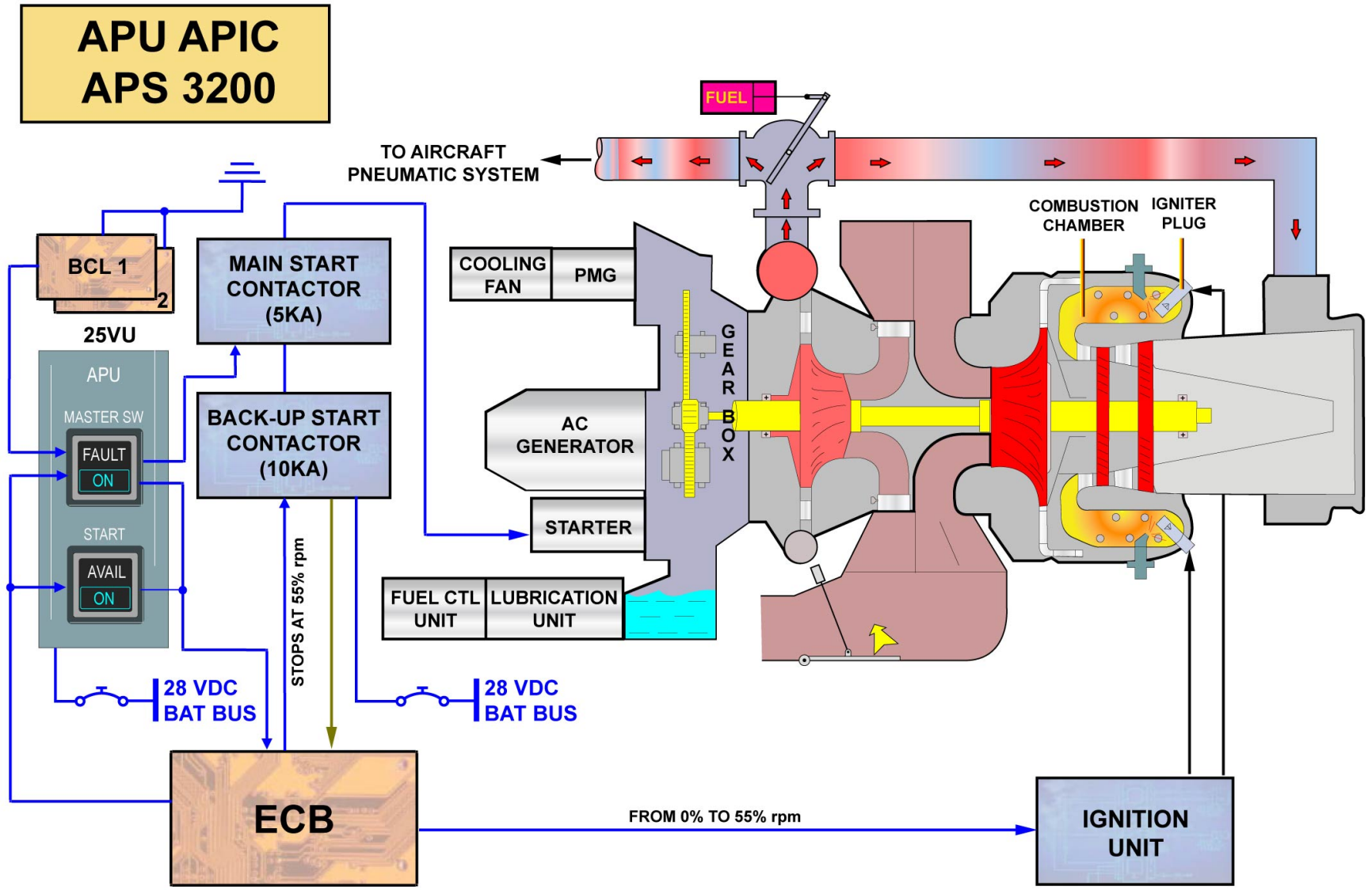
The starting system operates the Auxiliary Power Unit (APU) rotor through a clutch and gearbox. When the APU speed is 55% rpm, the start logic of the Electronic Control Box (ECB) stops the supply to the start contactors, which stops the starter motor. The timed acceleration loop of the ECB causes the APU to increase its speed until it gets to the governed speed.
During Ram Air Turbine (RAT) extension, APU starting is inhibited by the Battery Charge Limiters (BCL 1 and BCL 2). The BCLs remove the ground signal necessary to the operation of the Main Start Contactor from the MASTER SW, and thus prevent operation of the main start contactor 5 KA.

IGNITION CONTROL

The ignition system is used to ignite and maintain combustion during the start phase. The ignition system includes:
- an ignition unit,
- two ignition leads,
- two igniter plugs.

The ignition system operates from initial crank up to 55% rpm.

UGB13131 - U7ST0M0 - UM49D3000000003



STARTER CONTROL & IGNITION CONTROL

UGB13131 - U7ST0M0 - UM49D3000000003

APU FUEL SYSTEM D/O (3)

GENERAL

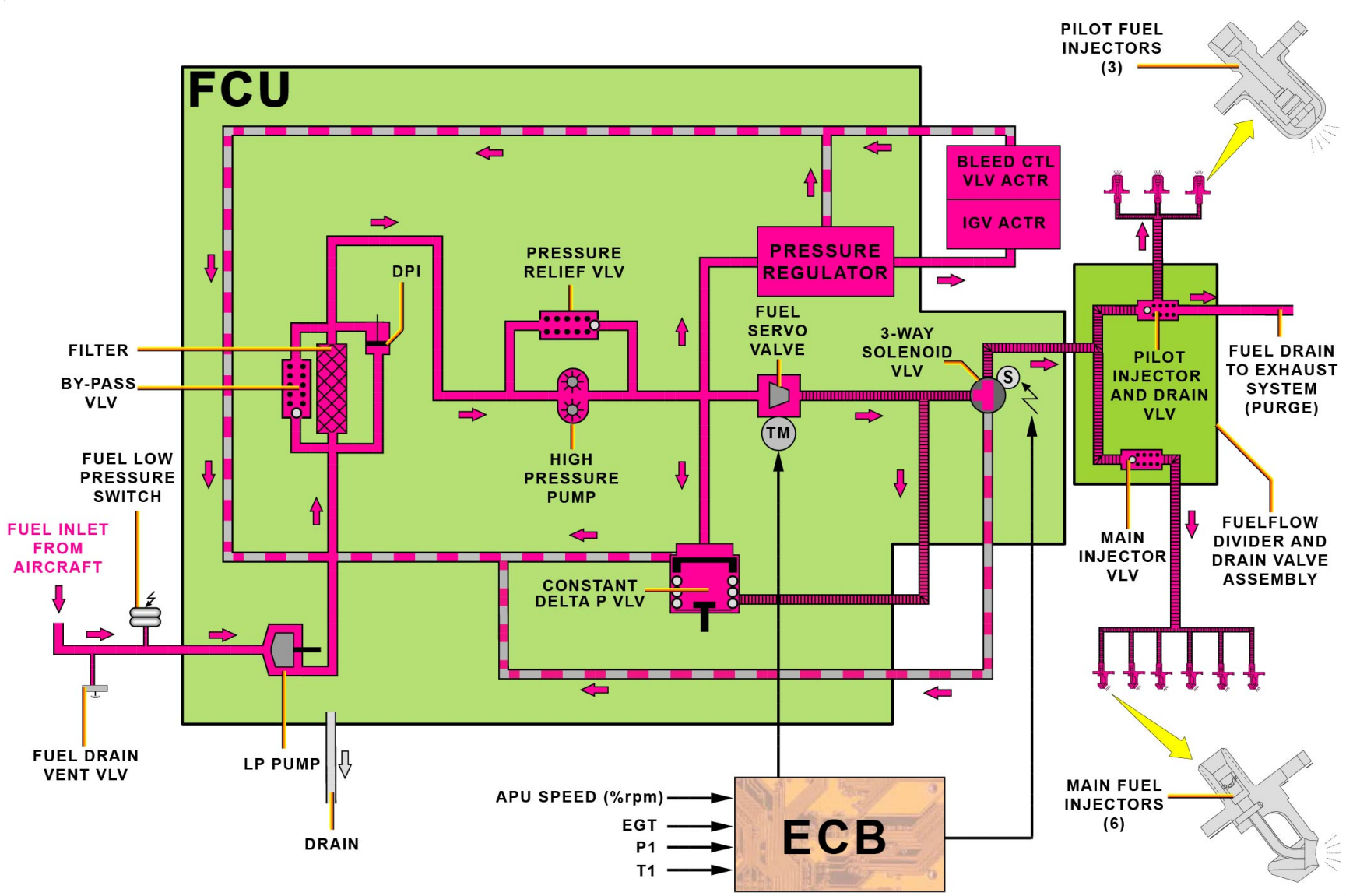
The fuel system provides metered fuel to sustain combustion. Part of the fuel is used as muscle pressure to operate the Inlet Guide Vane (IGV) actuator and the bleed control valve actuator.

FCU

The Fuel Control Unit (FCU) has five functions:
- fuel filtering,
- pressure increase,
- fuel metering,
- positive fuel shut-off,
- fuel muscle pressure regulation.

The FCU is composed of a Low Pressure (LP) fuel pump, a filter with a filter by-pass valve and a Differential Pressure Indicator (DPI), a High Pressure (HP) fuel pump with a pressure relief valve, a constant Differential Pressure (DELTA P) valve, a pressure regulator for the bleed control valve and the IGV actuators, a fuel servovalve, and the 3-way solenoid valve. A FCU drain line purges the pump shaft seal.

UGB13131 - U7ST0M0 - UM49D4000000003


FCU
PILOT FUEL INJECTORS (3)
BLEED CTL VLV ACTR
IGV ACTR
PRESSURE REGULATOR
PRESSURE RELIEF VLV
DPI
FILTER
BY-PASS VLV
FUEL SERVO VALVE
3-WAY SOLENOID VLV
S
TM
PILOT INJECTOR AND DRAIN VLV
FUEL DRAIN TO EXHAUST SYSTEM (PURGE)
FUEL LOW PRESSURE SWITCH
HIGH PRESSURE PUMP
FUEL INLET FROM AIRCRAFT
MAIN INJECTOR VLV
FUELFLOW DIVIDER AND DRAIN VALVE ASSEMBLY
CONSTANT DELTA P VLV
FUEL DRAIN VENT VLV
LP PUMP
DRAIN
APU SPEED (%rpm)
EGT
P1
T1
ECB
MAIN FUEL INJECTORS (6)

GENERAL & FCU

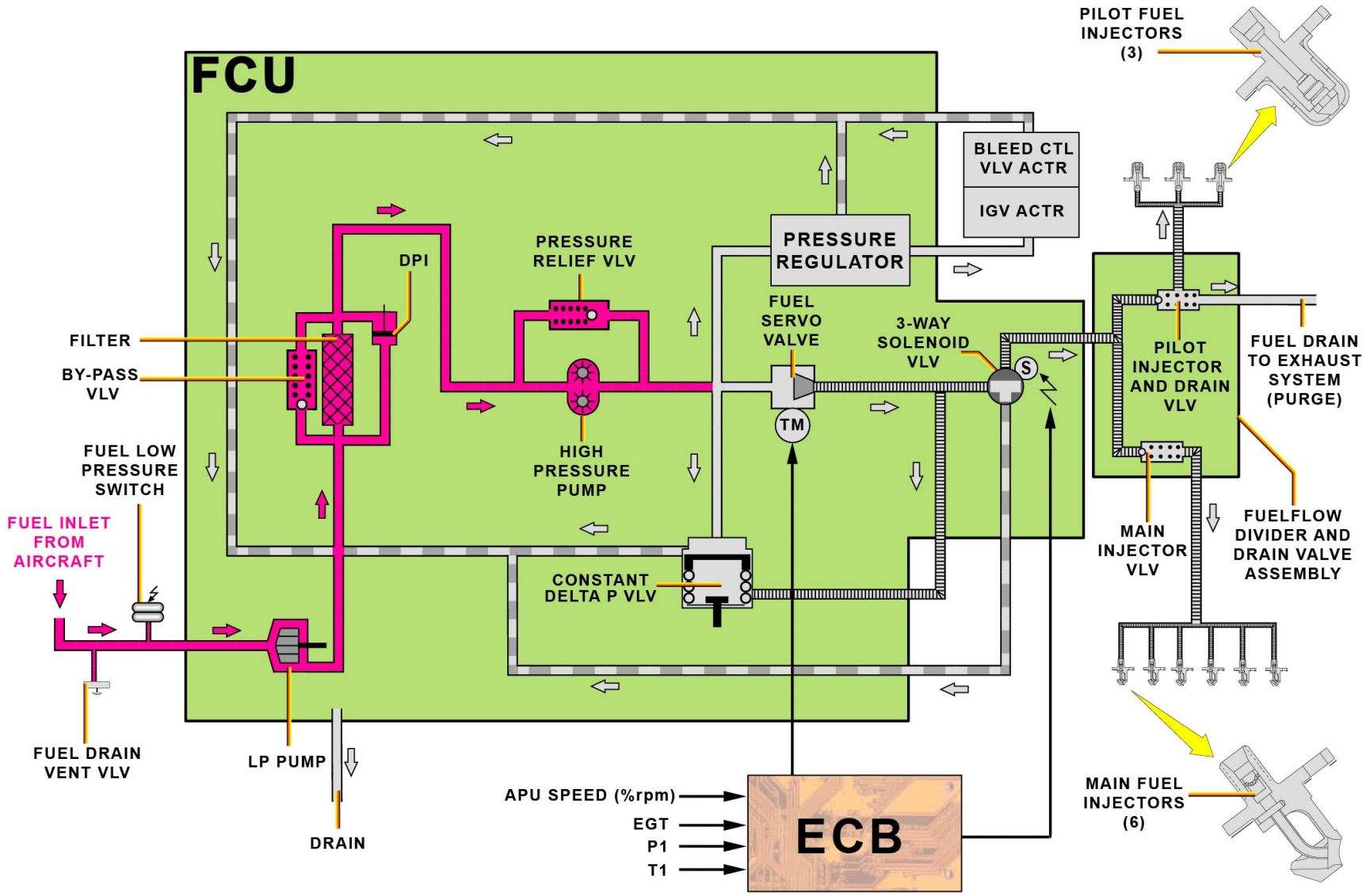
APU FUEL SYSTEM D/O (3)

APU START

FUEL PRESSURE

As the Auxiliary Power Unit (APU) is started the fuel coming from the aircraft fuel system flows through the Low Pressure (LP) pump, through a filter to the High Pressure (HP) pump.
If the filter becomes contaminated, the impending filter bypass will be indicated by the Differential Pressure Indicator (DPI). When the filter is blocked the by-pass valve will open. The HP pump has a pressure relief valve to cut off excessive pressure peaks.

UGB13131 - U7ST0M0 - UM49D4000000003



APU START - FUEL PRESSURE

UGB13131 - U7ST0M0 - UM49D400000003

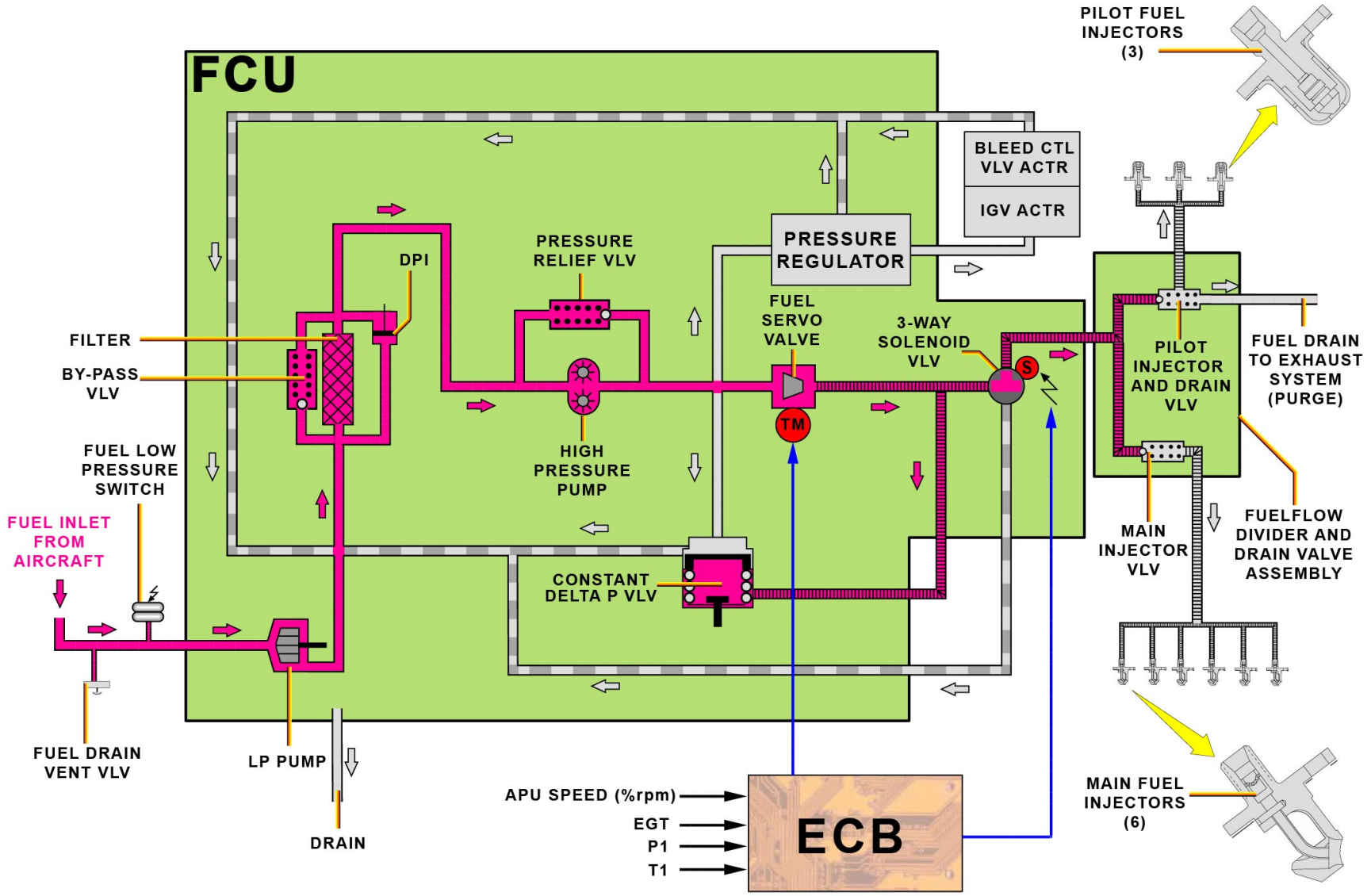
APU FUEL SYSTEM D/O (3)

APU START (continued)

ECB FUNCTIONS

During the APU start, the Electronic Control Box (ECB) energizes the 3-way solenoid valve and the Torque Motor (TM) of the fuel servo valve. The fuel, pressurized by the HP pump, then flows through the servo valve and through the 3-way solenoid valve to the flow divider. The ECB schedules fuel flow for start sequence, on speed operation and shutdown sequence. The ECB modulates the on-speed fuel schedule to match the A/C demand for bleed air and electrical load.

UGB13131 - U7ST0M0 - UM49D4000000003



APU START - ECB FUNCTIONS

UGB13131 - U7ST0M0 - UM49D400000003

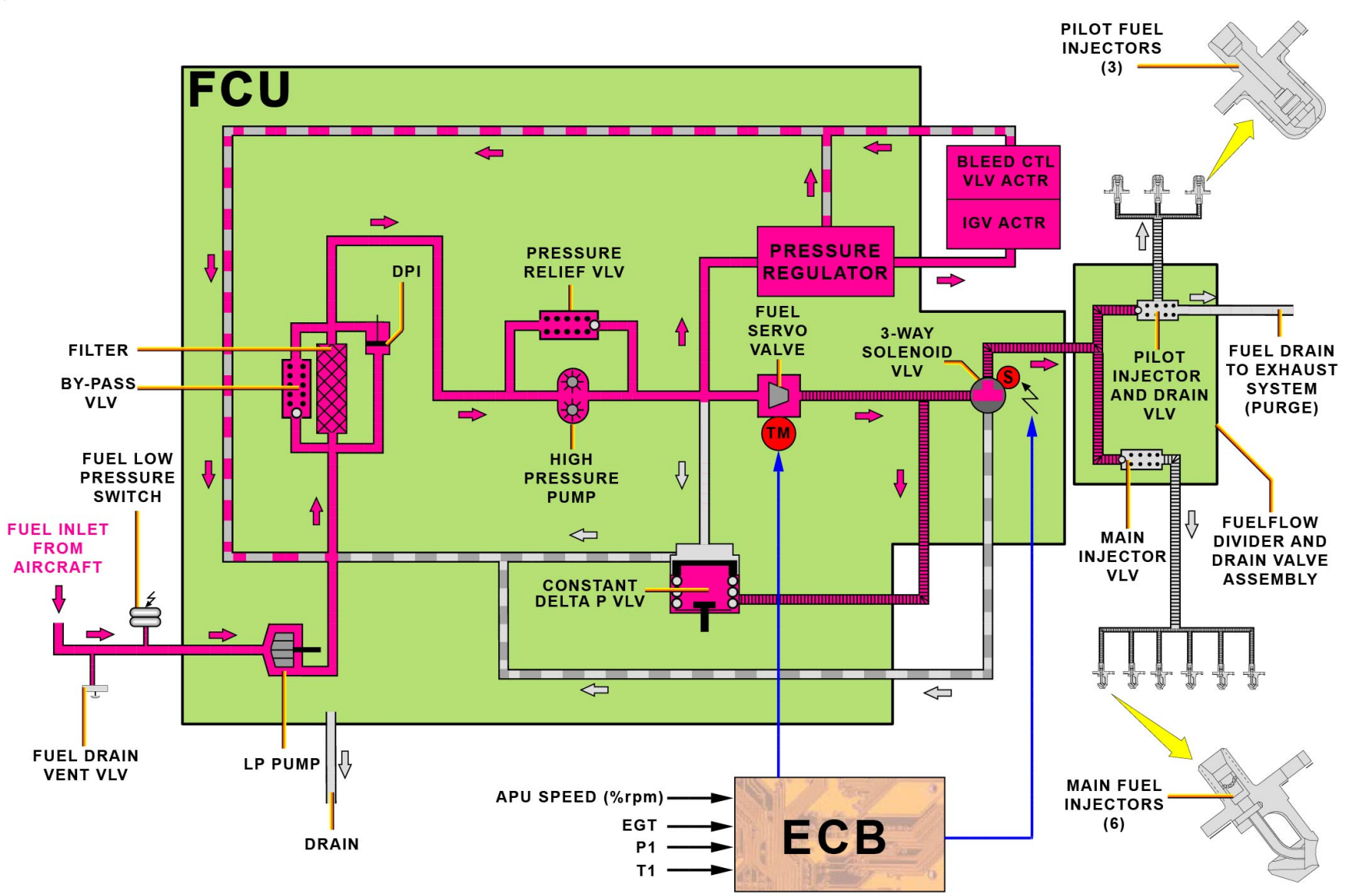
APU FUEL SYSTEM D/O (3)

APU START (continued)

FUEL SCHEDULE

From the HP pump, the fuel also flows to the pressure regulator. The fuel muscle pressure is used to operate the bleed control valve actuator, for the air delivery to the A/C and the air discharge to the exhaust, and for the load compressor IGV actuator. Servo fuel is returned downstream to the LP pump outlet and upstream to the fuel filter inlet.

UGB13131 - U7ST0M0 - UM49D4000000003



APU START - FUEL SCHEDULE

UGB13131 - U7ST0M0 - UM49D400000003

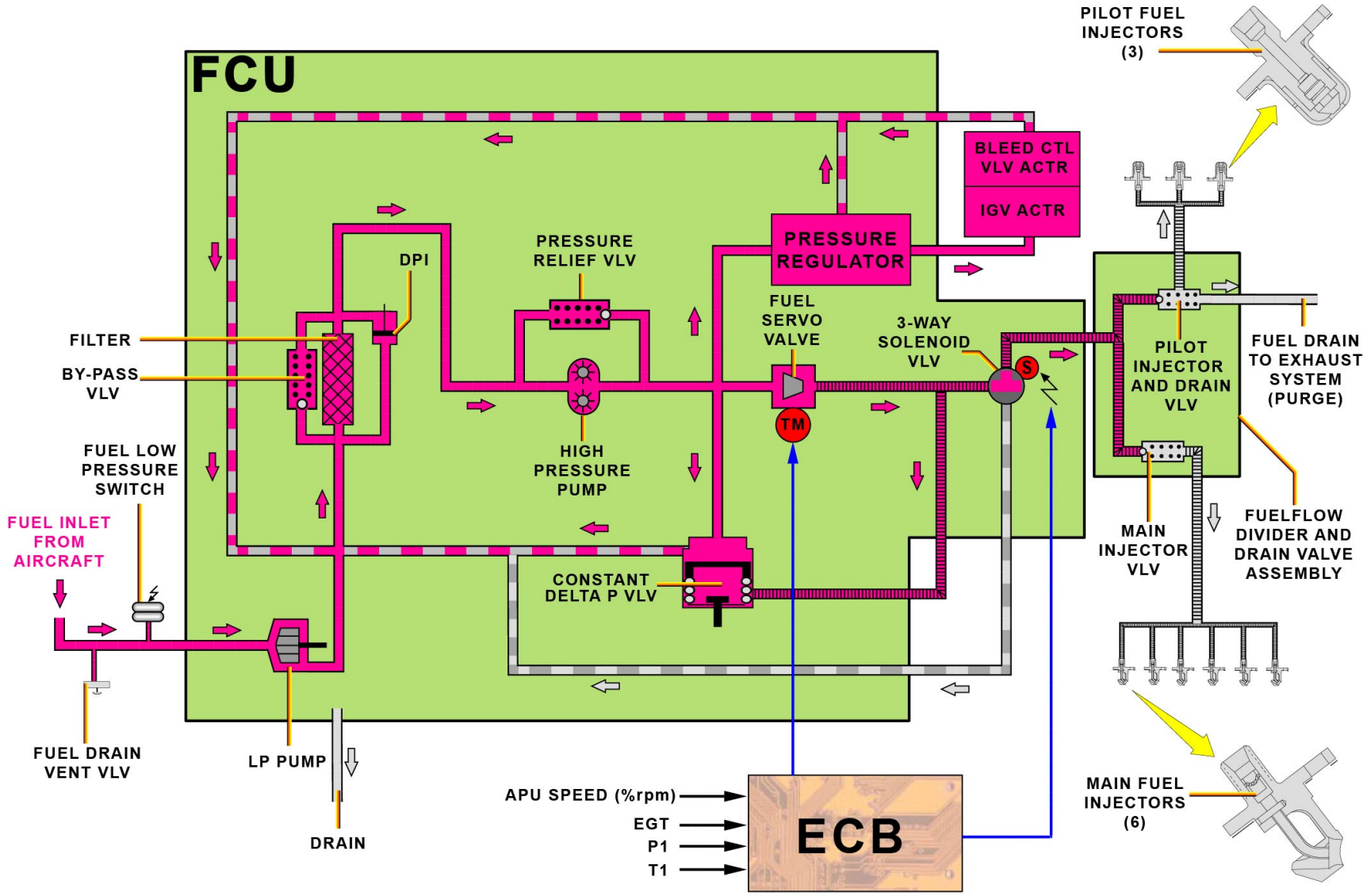
APU FUEL SYSTEM D/O (3)

APU START (continued)

DELTA PRESSURE VALVE

The constant Differential Pressure (DELTA P) valve lets excessive fuel from the HP pump flow back to the filter inlet and maintains a constant pressure difference across the servo valve.

UGB13131 - U7ST0M0 - UM49D4000000003



APU START - DELTA PRESSURE VALVE

UGB13131 - U7ST0M0 - UM49D400000003

APU FUEL SYSTEM D/O (3)

APU START (continued)

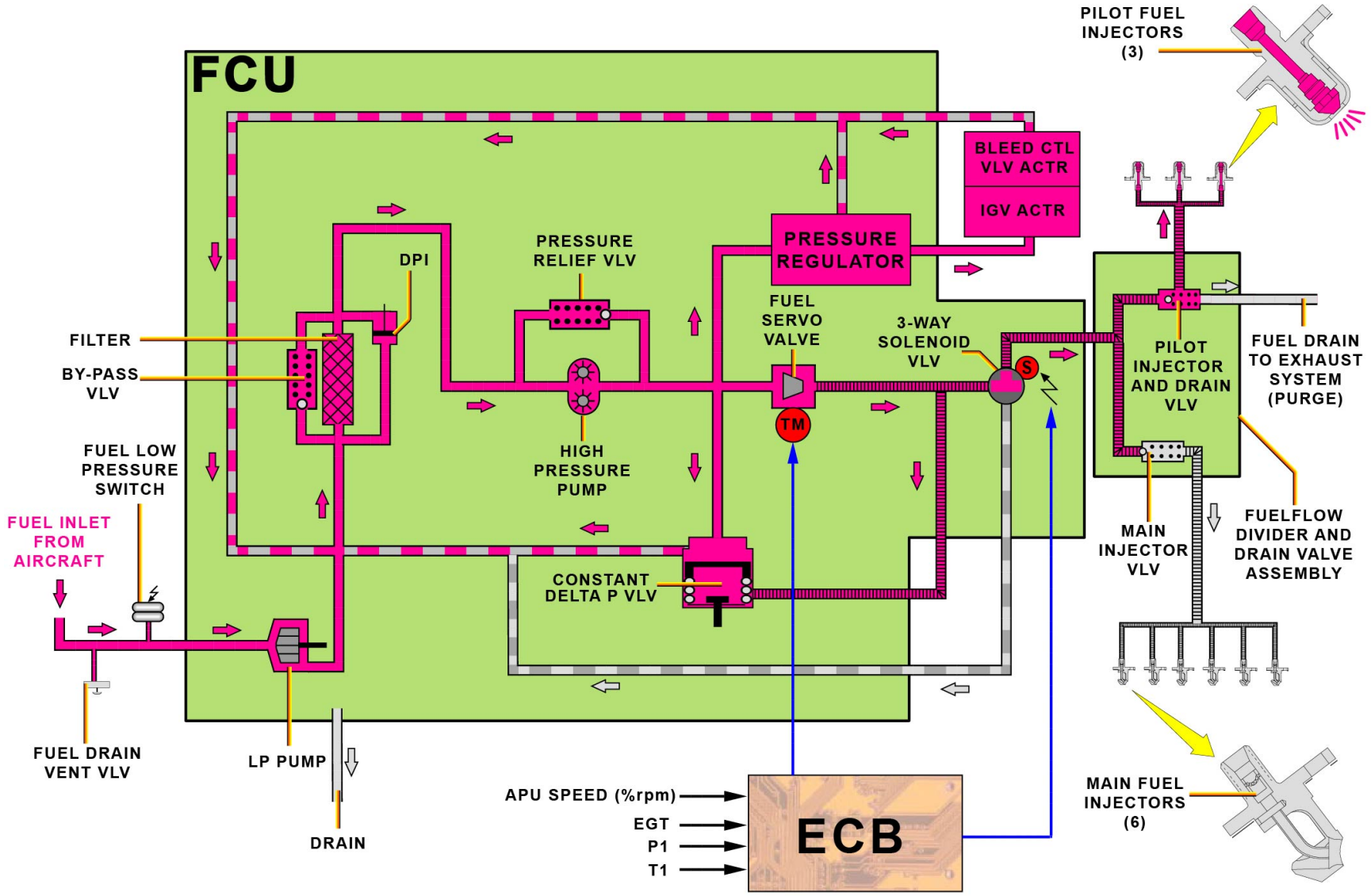
FLOW DIVIDER

The flow divider and drain valve assembly divides the fuel between the pilot and main injectors. During the start sequence, the pilot injector valve opens when the fuel pressure reaches 20 psi to initially supply the 3 pilot fuel injectors.

As the fuel pressure increases, the main injector valve opens and fuel is supplied to the 6 main fuel injectors. When the APU is running, the two valves are in the open position to supply all injectors.

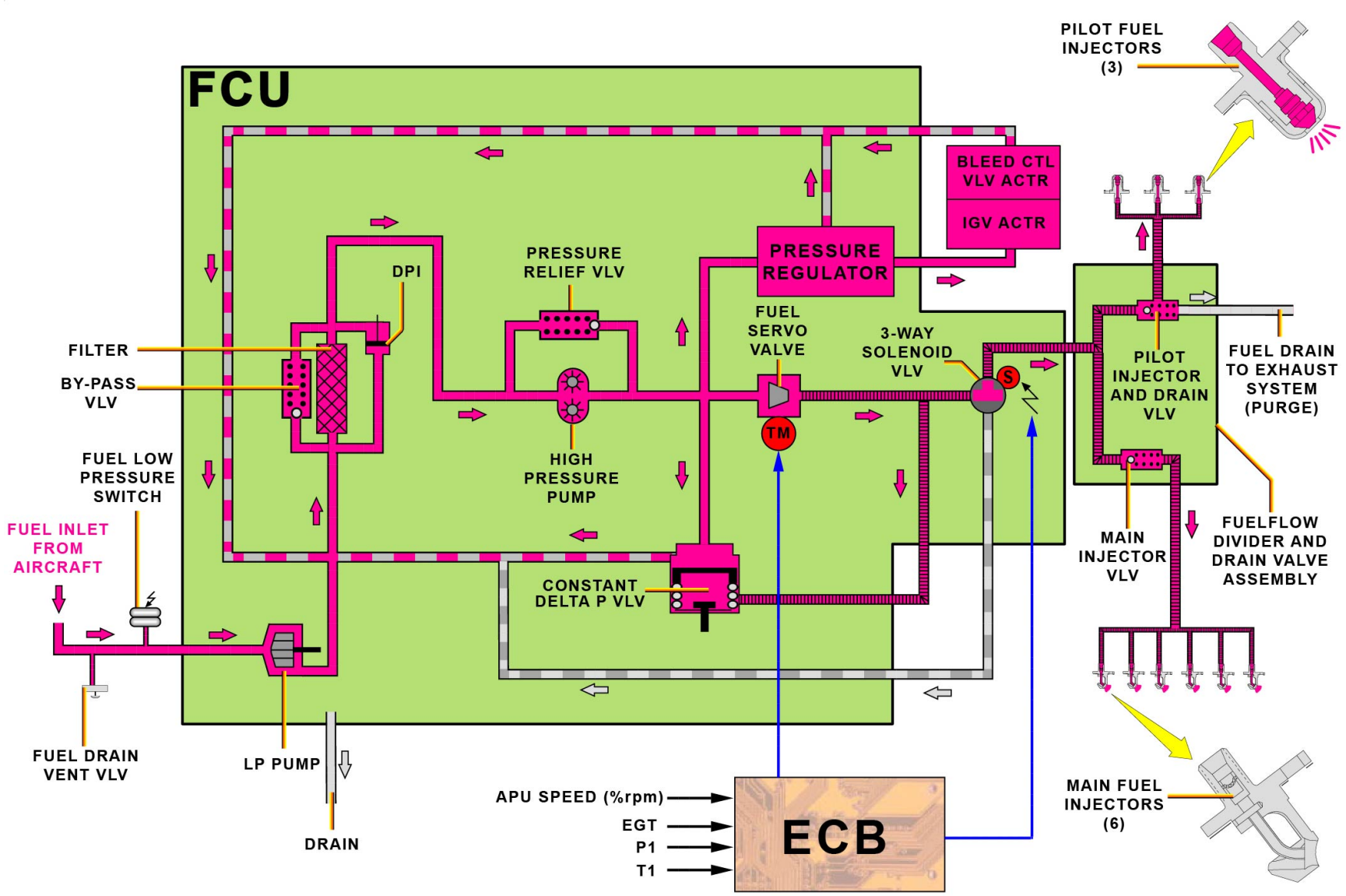
The ECB controls the fuel system using several parameters. During the start sequence, it uses APU speed, Exhaust Gas Temperature (EGT), air inlet pressure and temperature. During steady-state operation the ECB uses the speed only.

UGB13131 - U7ST0M0 - UM49D4000000003



APU START - FLOW DIVIDER

UGB13131 - U7ST0M0 - UM49D400000003



APU START - FLOW DIVIDER

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UGB13131 - U7ST0M0 - UM49D4000000003

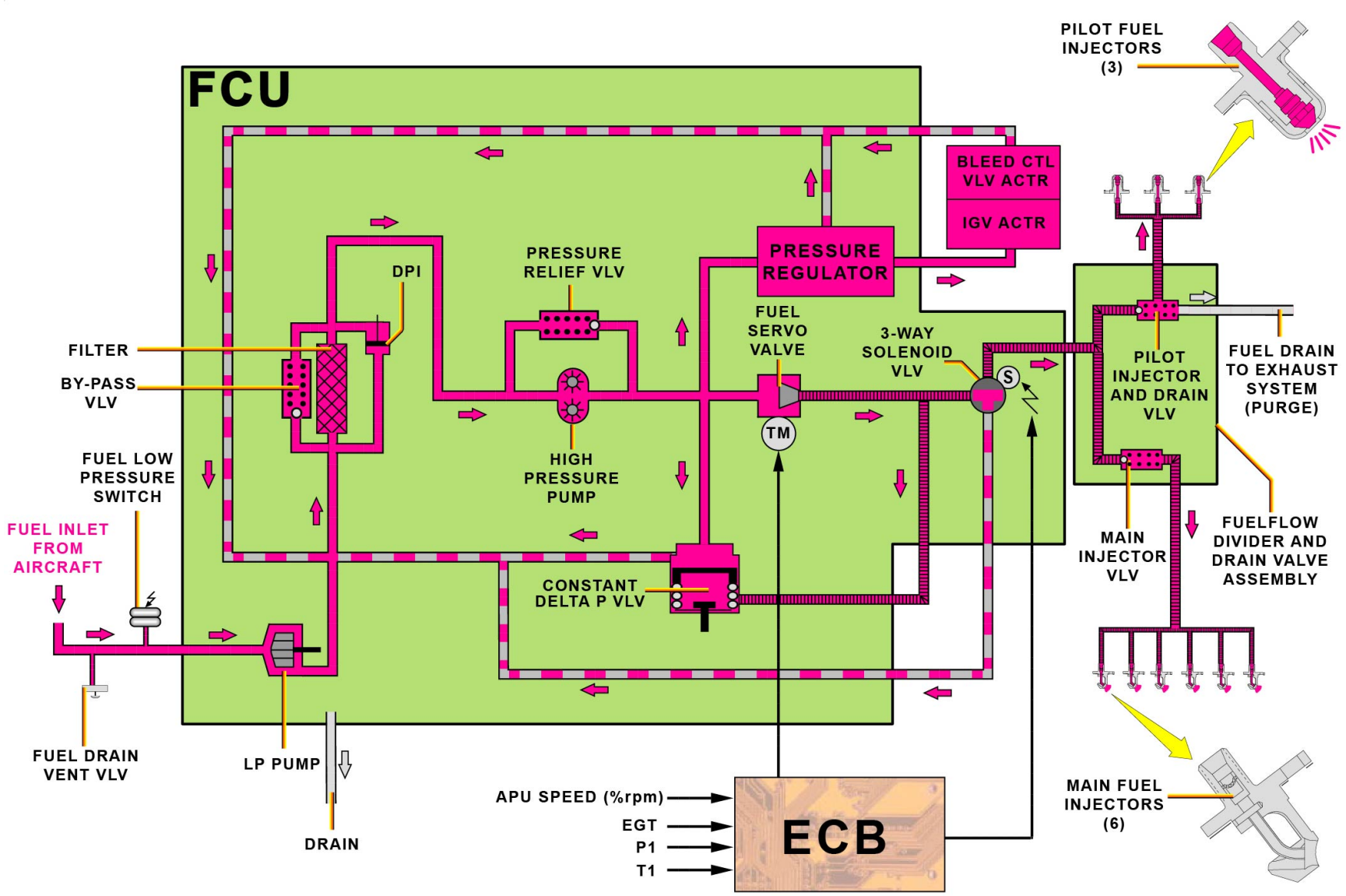
APU FUEL SYSTEM D/O (3)

APU SHUTDOWN

FUEL INJECTORS CUT OFF

When the APU shutdown is initiated, the ECB de-energizes the 3-way solenoid valve for positive fuel shut-off. Fuel is returned to the fuel filter inlet. The fuel supply to the fuel injectors is cut off.

UGB13131 - U7ST0M0 - UM49D400000003



APU SHUTDOWN - FUEL INJECTORS CUT OFF

UGB13131 - U7ST0M0 - UM49D400000003

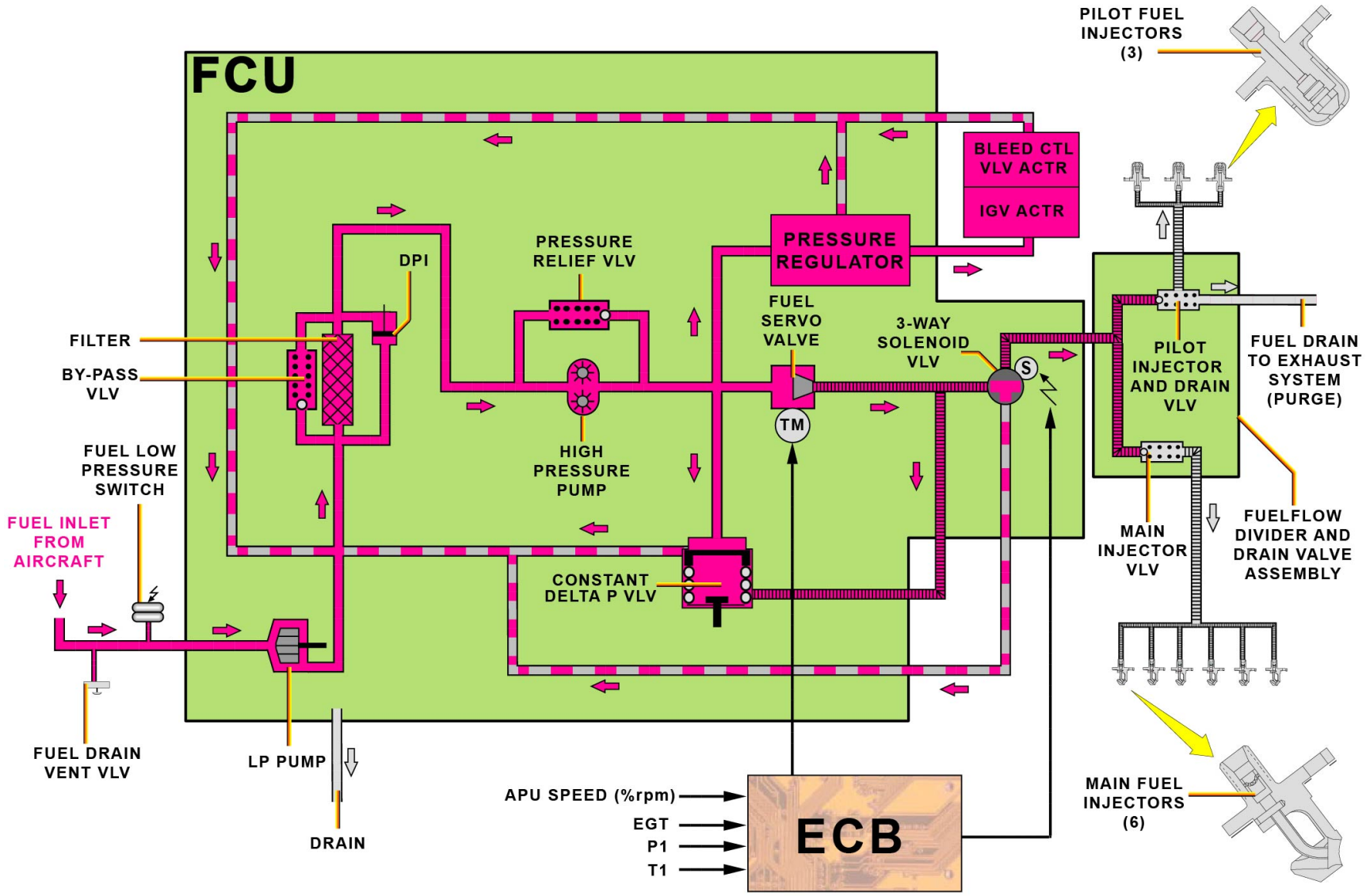
APU FUEL SYSTEM D/O (3)

APU SHUTDOWN (continued)

FUEL DRAIN AND VENT VALVE

As the fuel pressure decreases in the flow divider and drain valve assembly, the two injector valves close. The fuel remaining in the pilot injectors is purged to the APU exhaust by combustion chamber pressure.

UGB13131 - U7ST0M0 - UM49D4000000003



APU SHUTDOWN - FUEL DRAIN AND VENT VALVE

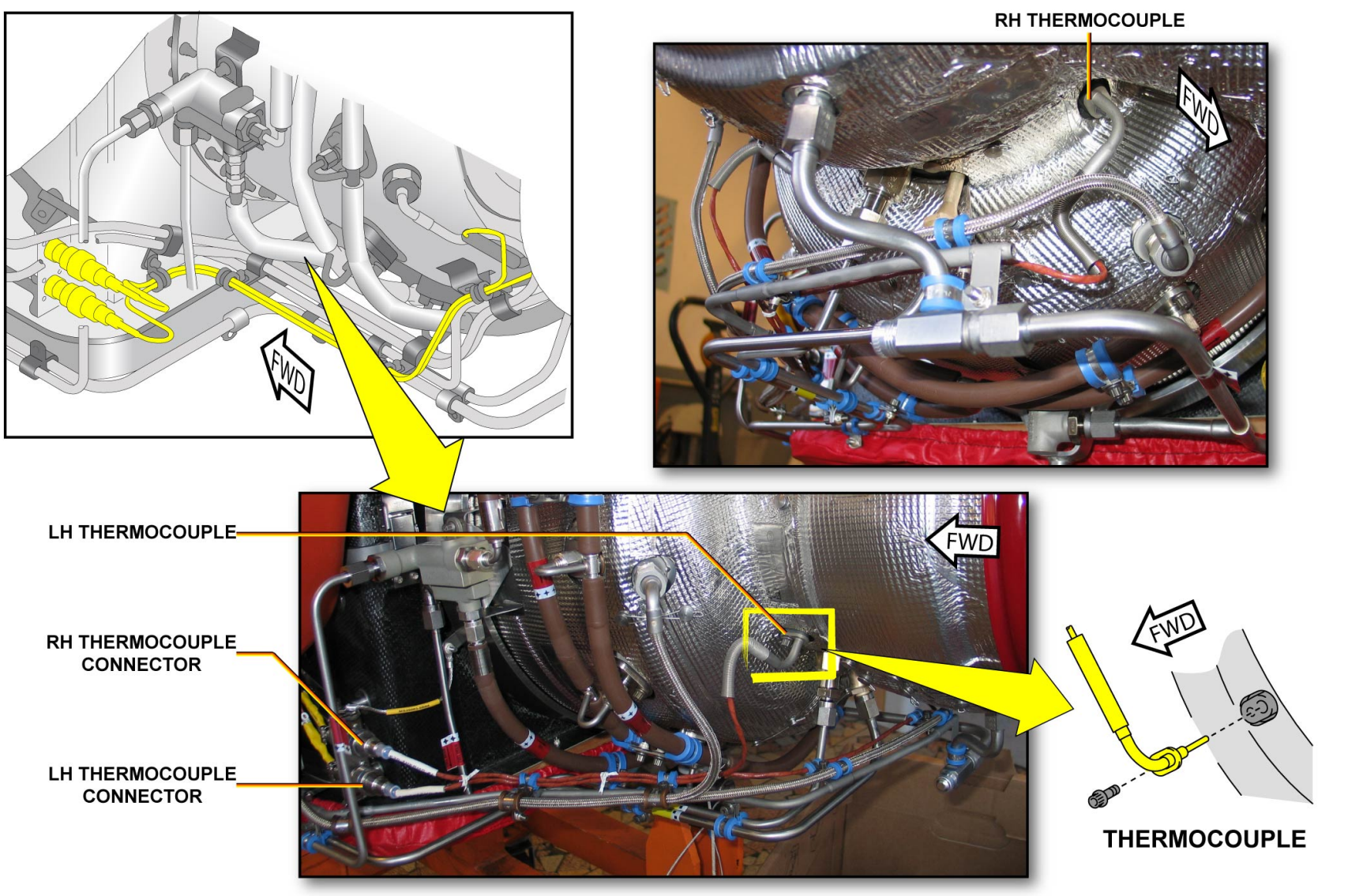
APU INDICATION SYSTEM (3)

TEMPERATURE INDICATING

EGT THERMOCOUPLE

Two Exhaust Gas Temperature (EGT) thermocouples are installed in the exhaust cone at the turbine discharge. The EGT thermocouple is a chromel-alumel device, which has two probes of different lengths. The EGT thermocouples supply a voltage in proportion to the EGT. This voltage is supplied through a shielded cable to the ECB 59KD. The two thermocouples are connected together and each thermocouple is connected to the ECB.

UGB13131 - U7ST0M0 - UM49D8APIC00002



TEMPERATURE INDICATING - EGT THERMOCOUPLE

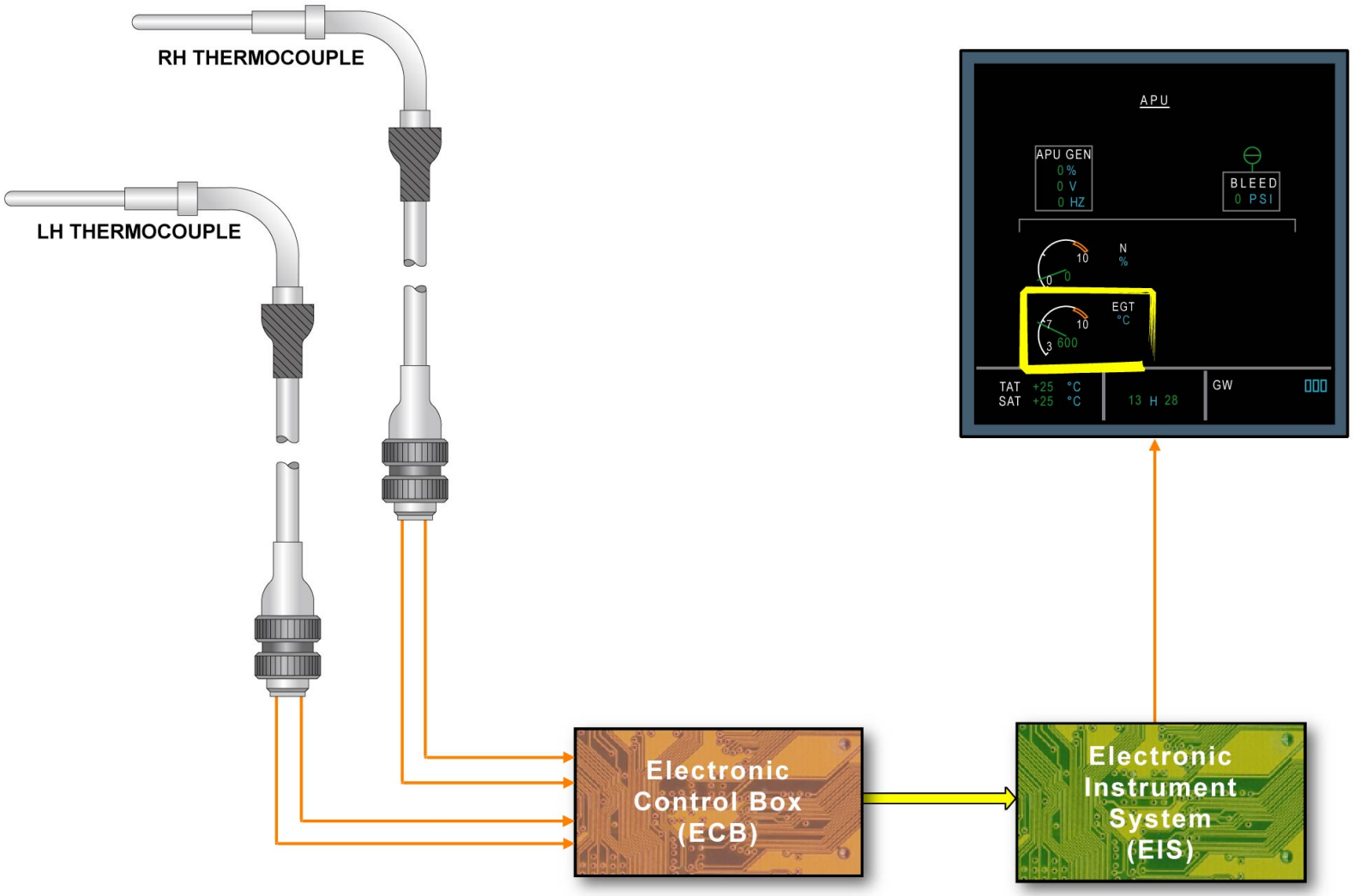
APU INDICATION SYSTEM (3)

TEMPERATURE INDICATING (continued)

TEMPERATURE MONITORING

Each thermocouple does the conversion of the thermal energy of the APU exhaust gas stream into an electrical voltage. This voltage increases in proportion to the EGT.
The ECB receives the signals of the two thermocouple rakes and makes an evaluation of the average temperature value that will be used for processing and indication.

UGB13131 - U7ST0M0 - UM49D8APIC00002



TEMPERATURE INDICATING - TEMPERATURE MONITORING

APU INDICATION SYSTEM (3)

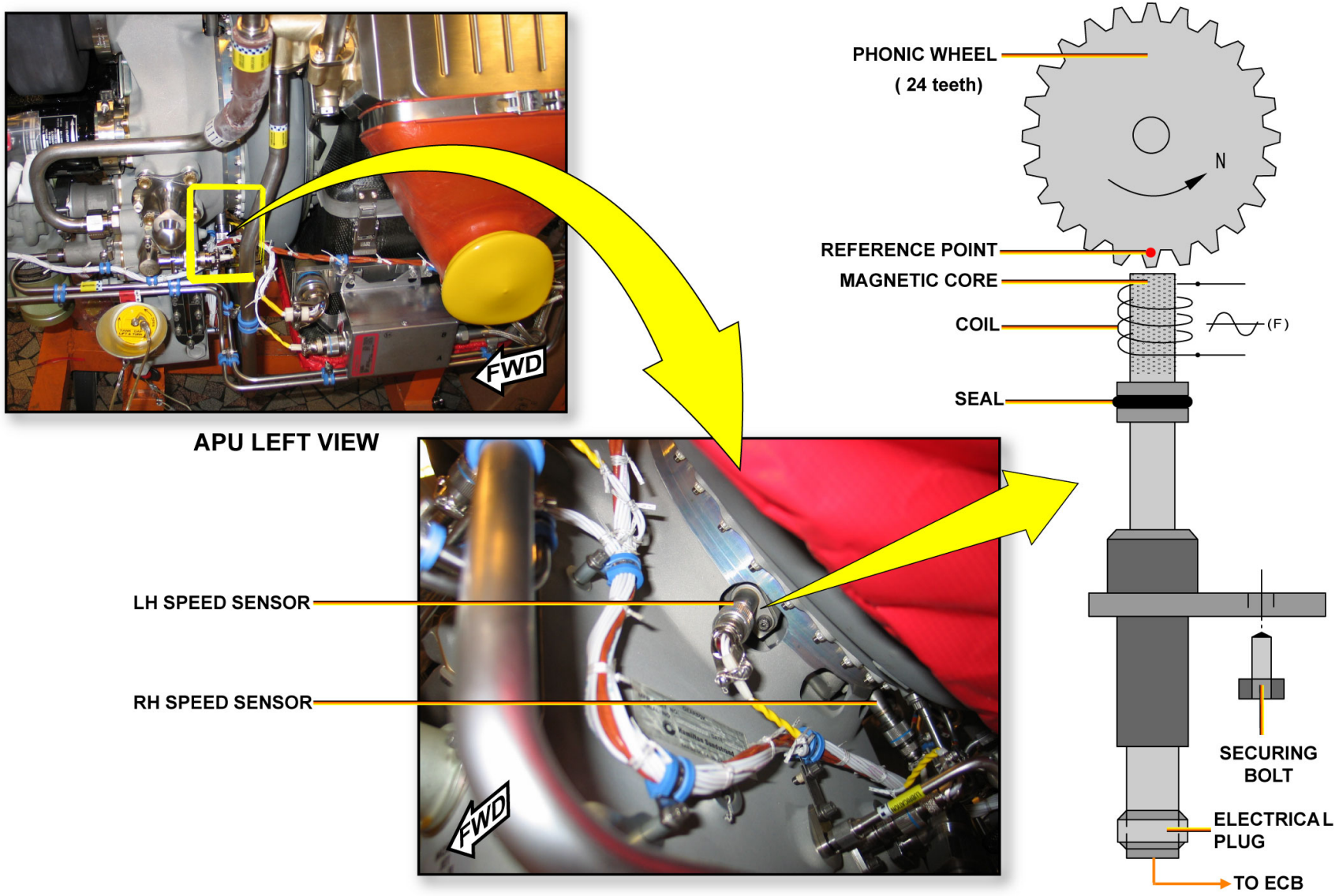
POWER INDICATING

SPEED SENSOR

Two speed sensors are installed in the gearbox casing. Each of the speed sensors is connected to the ECB.
The speed sensor has:
- a permanent magnet,
- a pole piece,
- a coil,
- a housing.

The speed sensors give the frequency in proportion to the APU speed.
A PMG is installed in the cooling fan of the accessory cooling system and it is used for back-up overspeed protection.

UGB13131 - U7ST0M0 - UM49D8APIC00002



POWER INDICATING - SPEED SENSOR

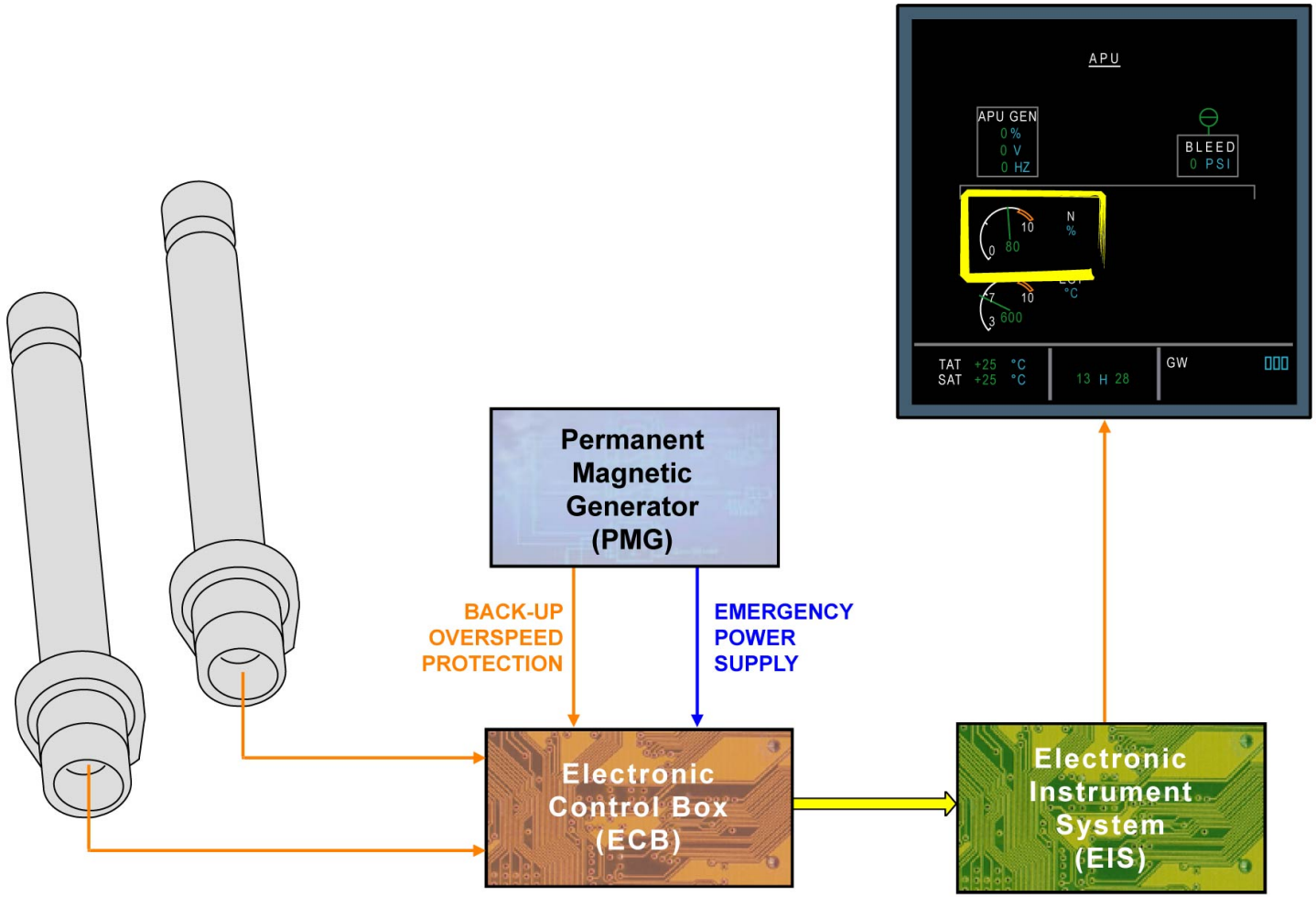
APU INDICATION SYSTEM (3)

POWER INDICATING (continued)

POWER MONITORING

The speed sensors measure the APU speed and transmit a frequency to the ECB. The ECB monitors the power indication during all APU operating conditions. The ECB starts the automatic shutdown sequence if there is a failure of the two speed sensors. The PMG transmits a speed signal to the ECB for back-up overspeed protection and supplies emergency power supply for the ECB.

UGB13131 - U7ST0M0 - UM49D8APIC00002



POWER INDICATING - POWER MONITORING

APU OIL SYSTEM D/O (3)

GENERAL

STORAGE

The sump of the Auxiliary Power Unit (APU) accessory gearbox is the oil reservoir. The accessory gearbox sump contains 5.2 l (1.4 US gal) of oil. On the left hand side of the gearbox, a gravity fill port is installed with a scupper to drain spilled oil. The gearbox has:
- a pressure fill port,
- an overflow port,
- a sight glass.

PROTECTION

The ECB protects the APU in case of oil system malfunction. The ECB monitors oil pressure and oil temperature. If one of the oil parameters is out of range, the ECB initiates an automatic APU shutdown without time delay.
- gearbox High Oil Temperature (HOT) threshold: 135°C (275°F),
- AC generator high oil temp: 180°C (356°F),
- Low Oil Pressure (LOP): 35 psi.

MONITORING

The oil system is monitored to increase the APU life. Lube and scavenge filters have visual clogging indicators. The oil sump has a low level sensor to show maintenance information in the cockpit. When the level is at the "ADD" mark 4l (1 US gal) the APU is able to continue running for at least 60 hours. A magnetic drain plug, immersed in the APU oil, is used for the oil drainage from the sump and attracts ferrous metal particles. Two Differential Pressure (DELTA P) switches, one for the scavenge filter and a second one for the pressure filter are use for the ECB in case of clogging situation and an APU auto shutdown is triggered.

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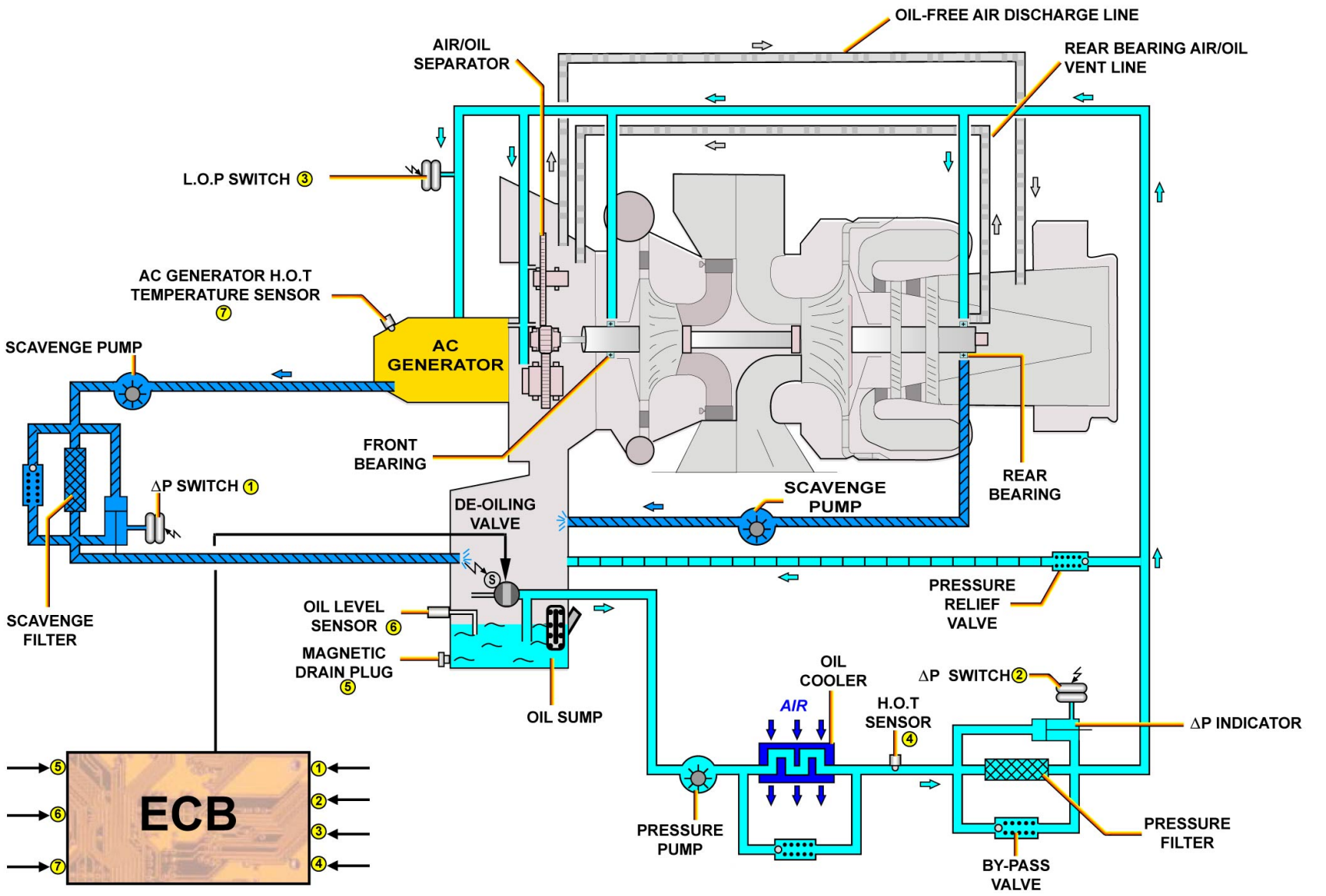
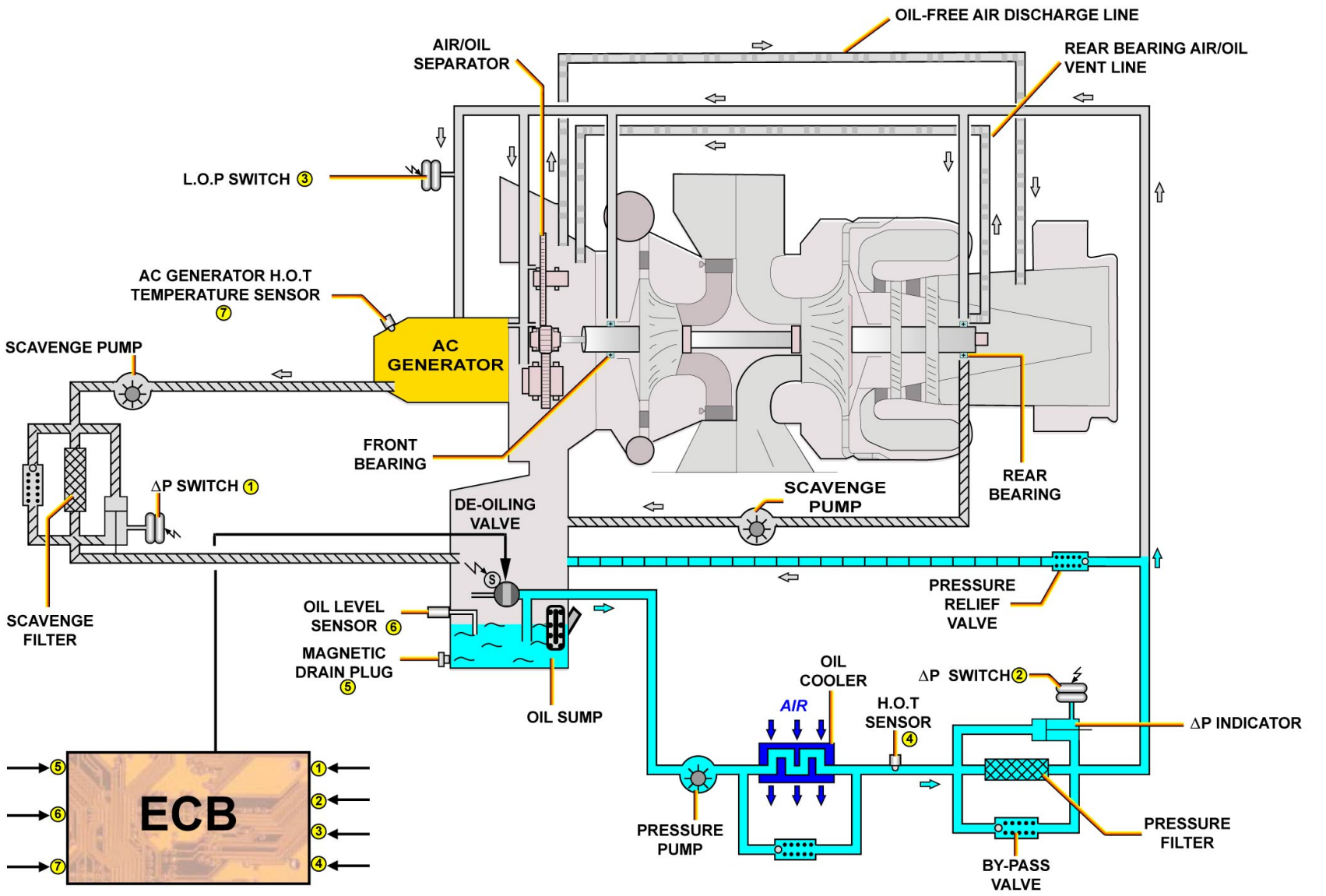


GENERAL - STORAGE ... MONITORING

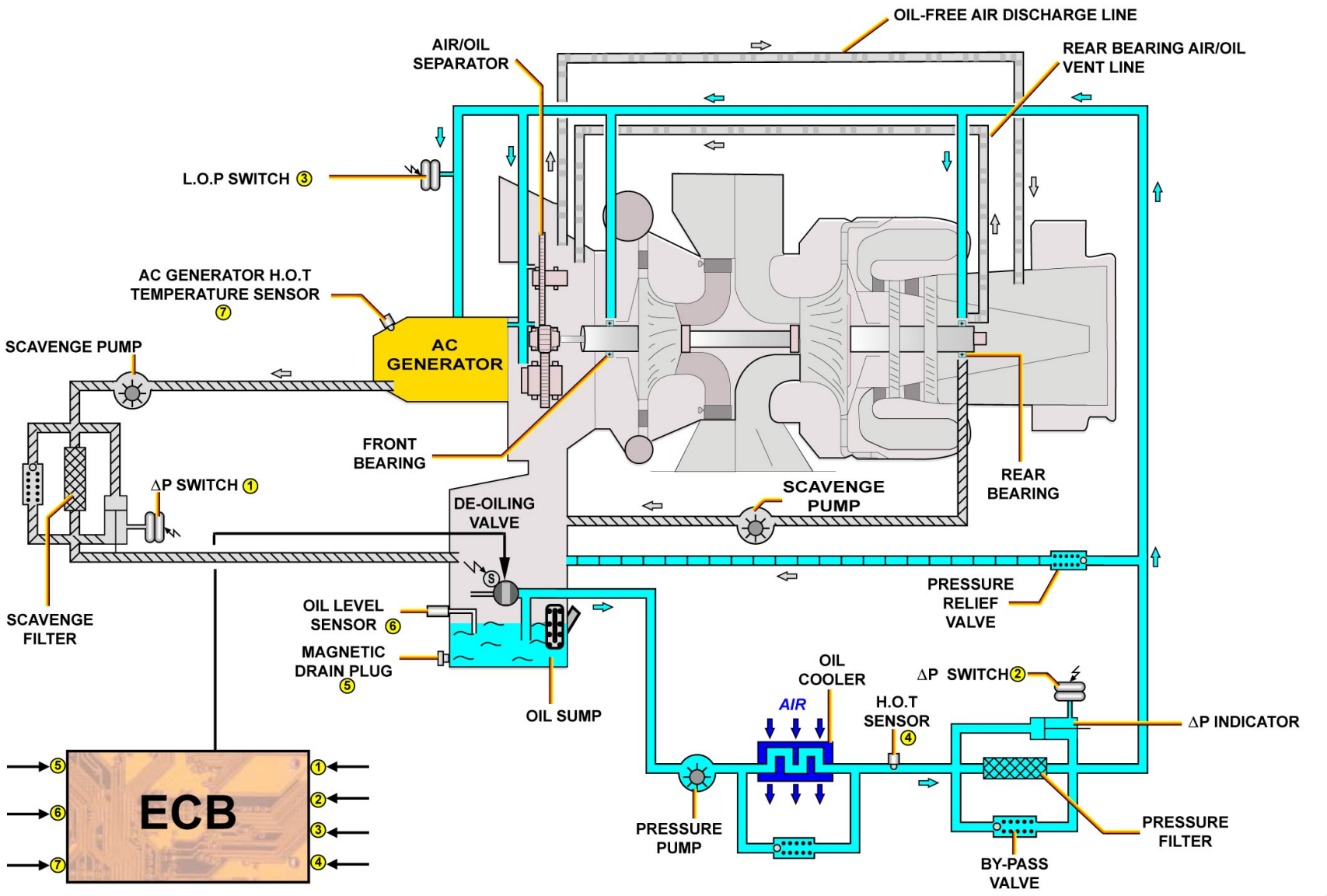
APU OIL SYSTEM D/O (3)

SUPPLY

The oil is drawn from the sump and pressurized by a vane-type pressure pump. The pressurized oil goes through a cooler and a disposable filter. If the pump pressure is too high, a pressure relief valve opens and releases oil back to the pump inlet.
The oil is then directed to the gears and bearings of the accessory gearbox, the load compressor front bearing, the power section rear bearing and the electrical generator.


OIL-FREE AIR DISCHARGE LINE
AIR/OIL SEPARATOR
REAR BEARING AIR/OIL VENT LINE
L.O.P SWITCH 3
AC GENERATOR H.O.T TEMPERATURE SENSOR 7
AC GENERATOR
SCAVENGE PUMP
FRONT BEARING
REAR BEARING
ΔP SWITCH 1
DE-OILING VALVE
SCAVENGE PUMP
PRESSURE RELIEF VALVE
SCAVENGE FILTER
OIL LEVEL SENSOR 6
MAGNETIC DRAIN PLUG 5
OIL SUMP
OIL COOLER
AIR
ΔP SWITCH 2
H.O.T SENSOR 4
ΔP INDICATOR
ECB
PRESSURE PUMP
PRESSURE FILTER
BY-PASS VALVE

SUPPLY


OIL-FREE AIR DISCHARGE LINE
AIR/OIL SEPARATOR
REAR BEARING AIR/OIL VENT LINE
L.O.P SWITCH 3
AC GENERATOR H.O.T TEMPERATURE SENSOR 7
AC GENERATOR
SCAVENGE PUMP
FRONT BEARING
REAR BEARING
ΔP SWITCH 1
DE-OILING VALVE
SCAVENGE PUMP
PRESSURE RELIEF VALVE
SCAVENGE FILTER
OIL LEVEL SENSOR 6
MAGNETIC DRAIN PLUG 5
OIL SUMP
OIL COOLER
AIR
ΔP SWITCH 2
H.O.T SENSOR 4
ΔP INDICATOR
ECB
PRESSURE PUMP
PRESSURE FILTER
BY-PASS VALVE

SUPPLY

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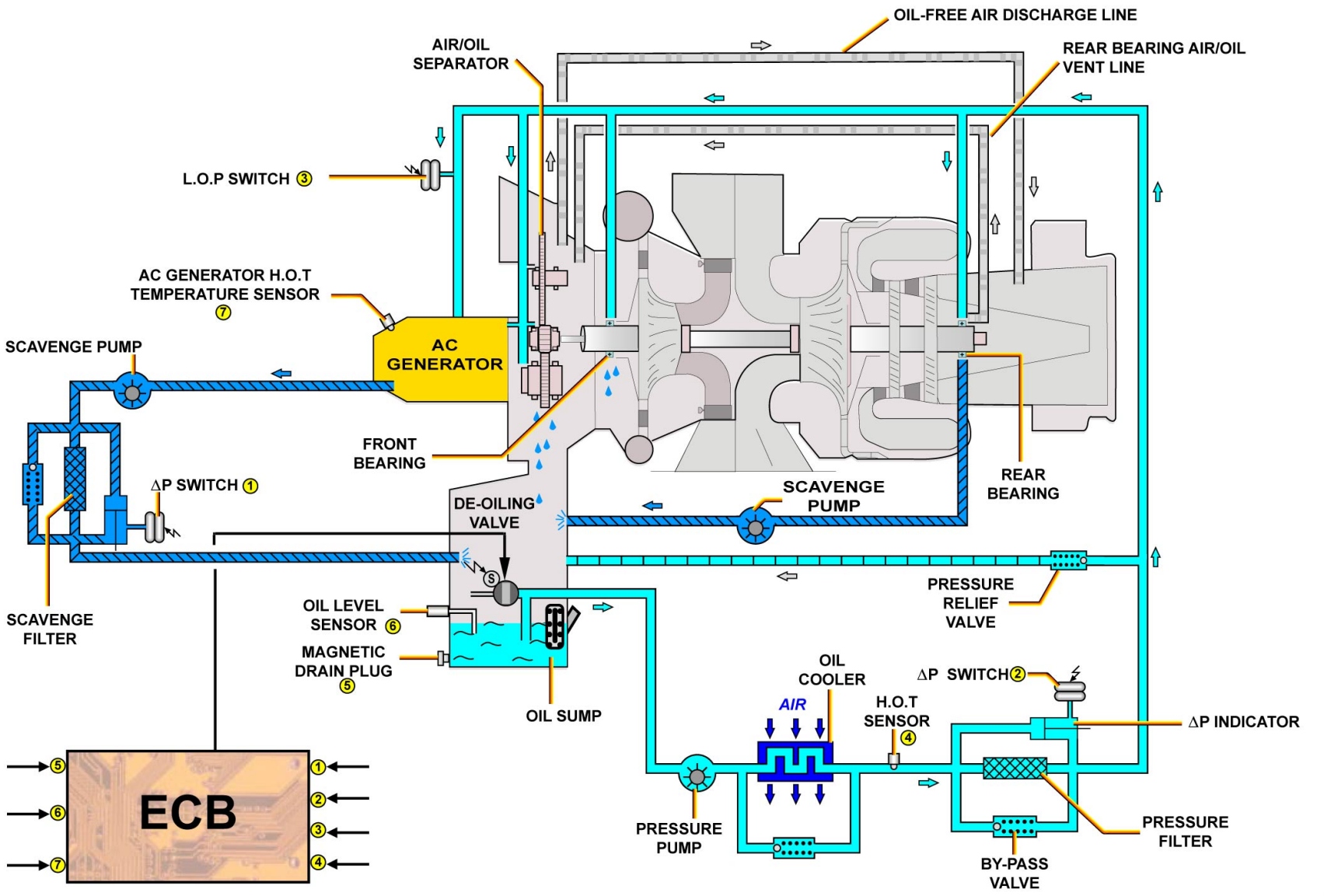
APU OIL SYSTEM D/O (3)

SCAVENGE

Oil from the electrical generator and the APU rear bearing is returned to the sump by two scavenge pumps. The oil from the AC generator returns to the sump through a vane-type scavenge pump and a filter. The oil from the APU rear bearing returns to the sump through a scavenge pump. Oil from the gearbox pinions and the APU front bearing is scavenged by gravity.

UGB13131 - U7ST0M0 - UM49D5000000003

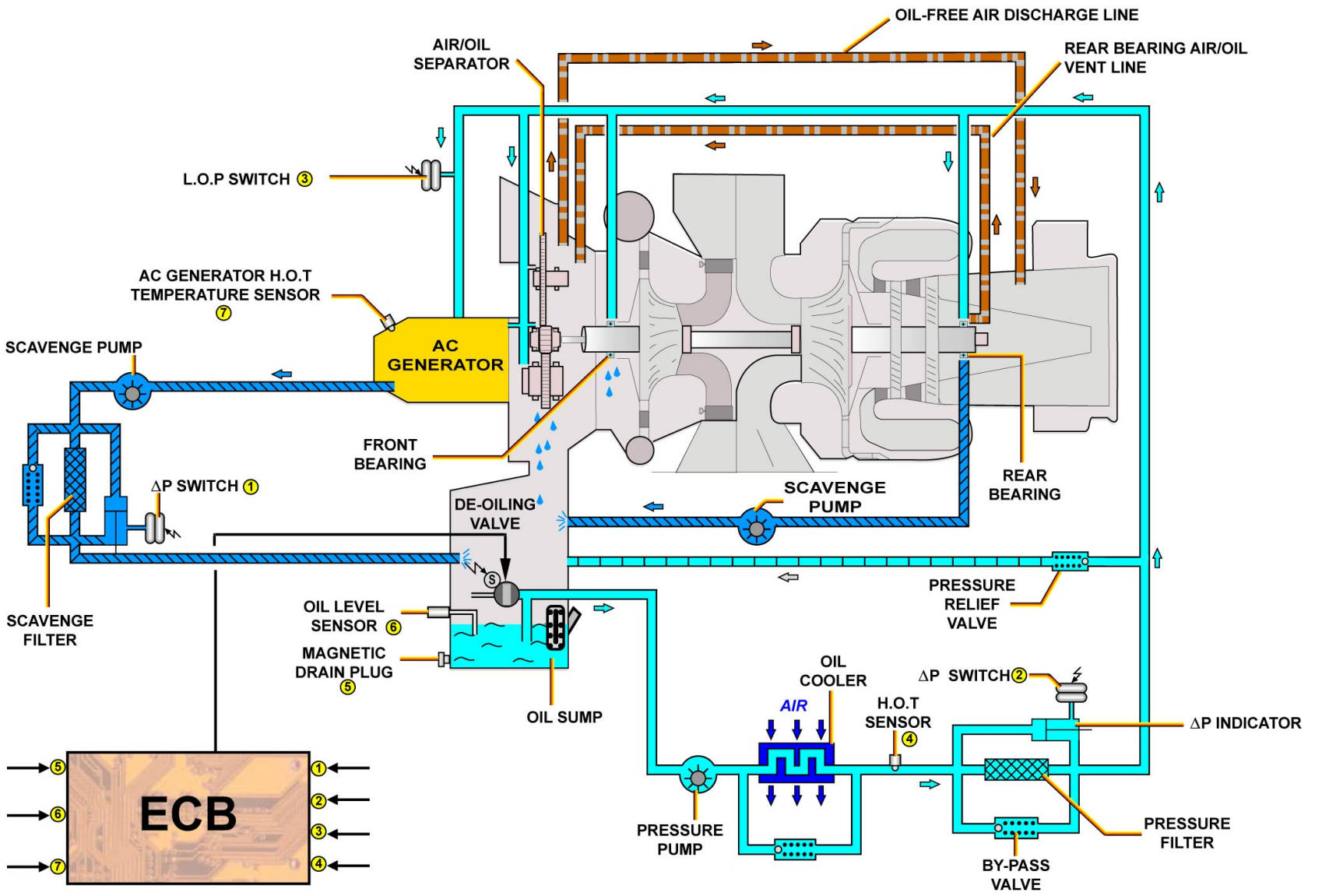

OIL-FREE AIR DISCHARGE LINE
AIR/OIL SEPARATOR
REAR BEARING AIR/OIL VENT LINE
L.O.P SWITCH 3
AC GENERATOR H.O.T TEMPERATURE SENSOR 7
AC GENERATOR
SCAVENGE PUMP
FRONT BEARING
REAR BEARING
ΔP SWITCH 1
DE-OILING VALVE
SCAVENGE PUMP
PRESSURE RELIEF VALVE
SCAVENGE FILTER
OIL LEVEL SENSOR 6
MAGNETIC DRAIN PLUG 5
OIL SUMP
OIL COOLER
AIR
ΔP SWITCH 2
H.O.T SENSOR 4
ΔP INDICATOR
ECB
PRESSURE PUMP
PRESSURE FILTER
BY-PASS VALVE

SCAVENGE

APU OIL SYSTEM D/O (3)

VENTING

The air oil mist from the rear bearing is returned to the gearbox housing through an external pipe. An air/oil separator removes the oil particles from the gearbox air. This oil-free air is discharged in the APU exhaust.


OIL-FREE AIR DISCHARGE LINE
AIR/OIL SEPARATOR
REAR BEARING AIR/OIL VENT LINE
L.O.P SWITCH 3
AC GENERATOR H.O.T TEMPERATURE SENSOR 7
AC GENERATOR
SCAVENGE PUMP
FRONT BEARING
REAR BEARING
ΔP SWITCH 1
DE-OILING VALVE
SCAVENGE PUMP
PRESSURE RELIEF VALVE
SCAVENGE FILTER
OIL LEVEL SENSOR 6
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ΔP SWITCH 2
H.O.T SENSOR 4
ΔP INDICATOR
ECB
PRESSURE PUMP
PRESSURE FILTER
BY-PASS VALVE

VENTING

APU OIL SYSTEM D/O (3)

DE-OILING SOLENOID FUNCTION

The only component of the oil system controlled by the Electronic Control Box (ECB) is the de-oiling valve.

DURING START

Especially during the cold start condition; the oil has a high viscosity. The de-oiling solenoid valve reduces the oil pressure pump load at any APU start by allowing air to enter the inlet of the oil supply pump. Above 55% APU speed, the ECB de-energizes the solenoid and the de-oiling valve closes.

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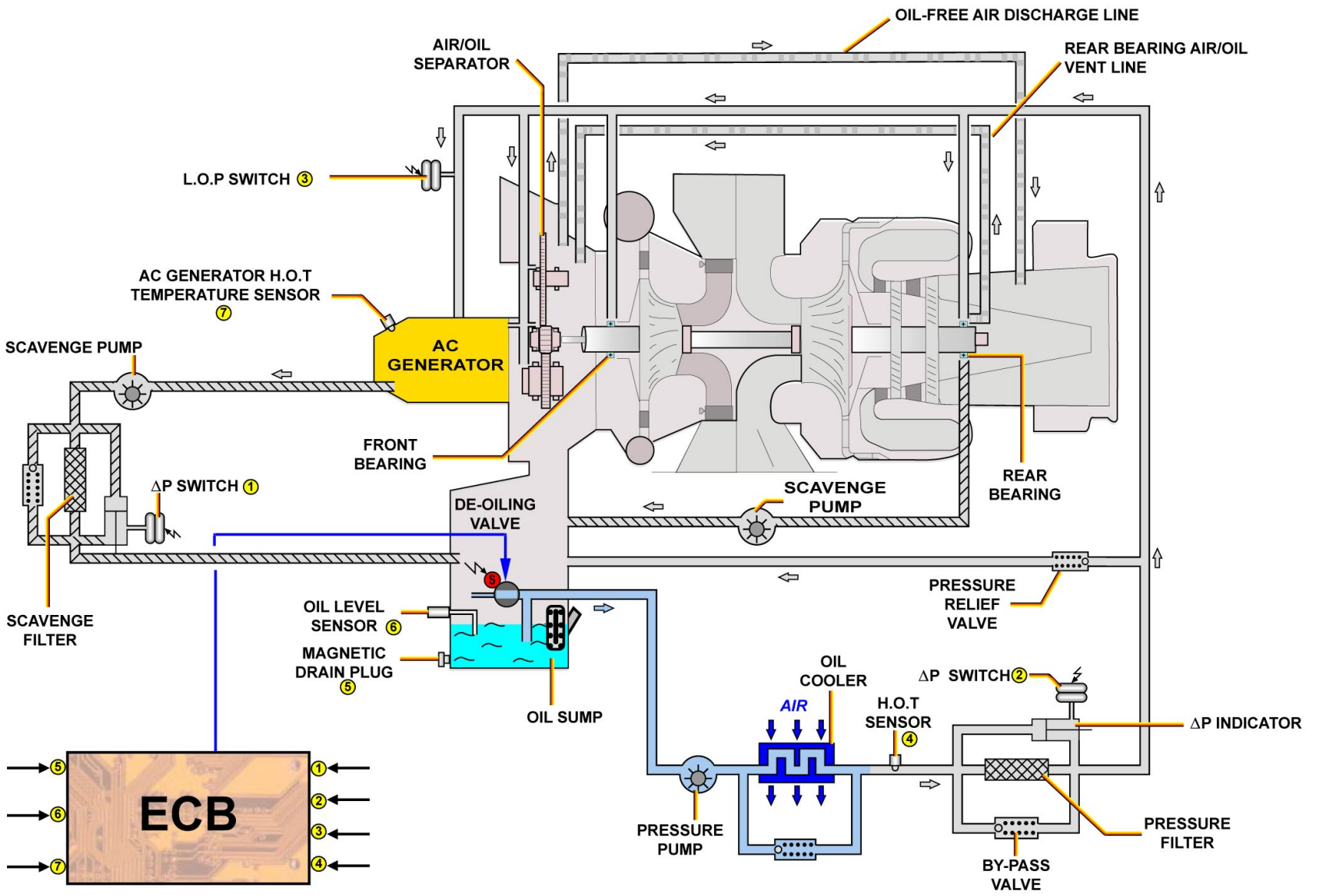


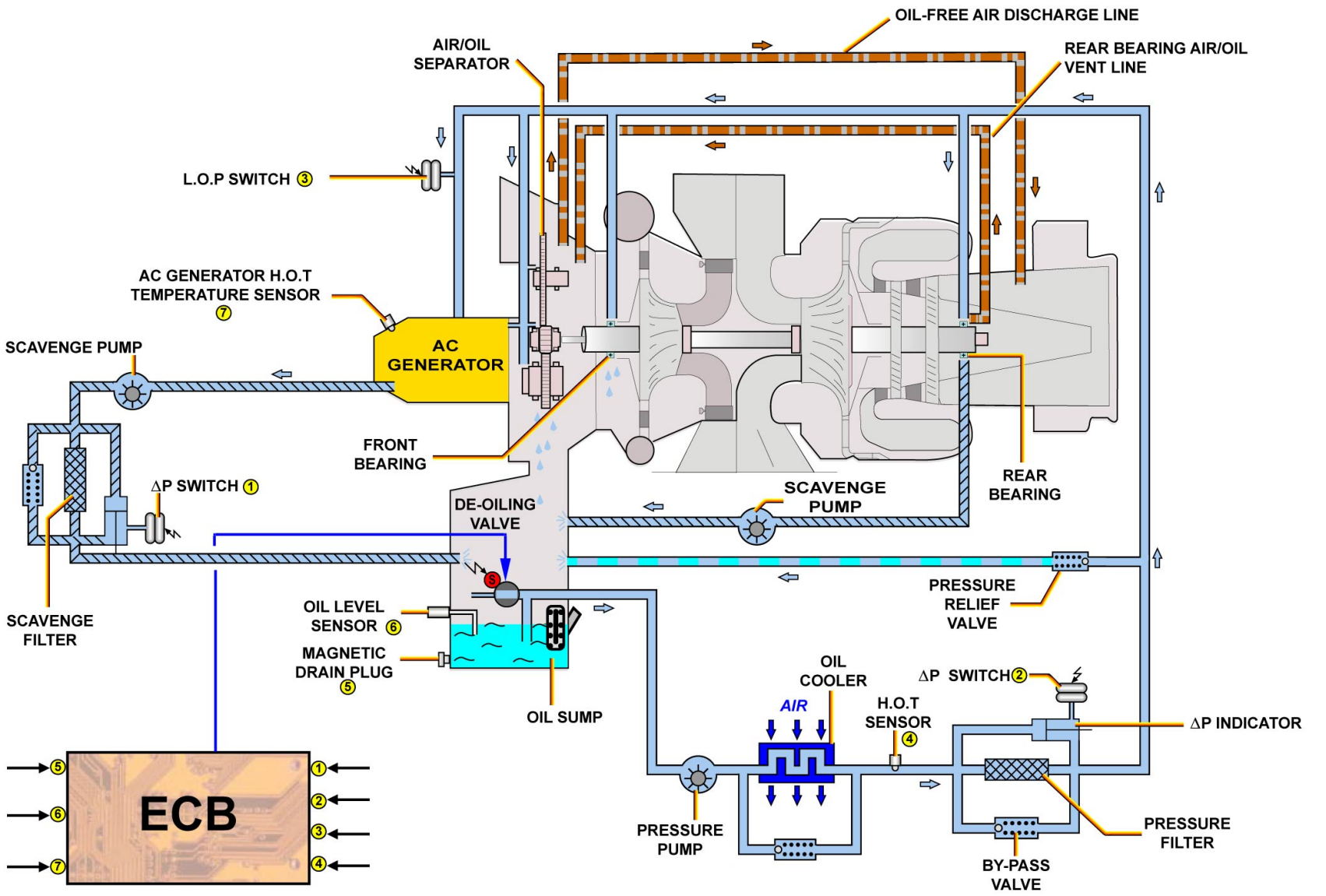
DE-OILING SOLENOID FUNCTION - DURING START

APU OIL SYSTEM D/O (3)

DE-OILING SOLENOID FUNCTION (continued)

DURING SHUT DOWN

During the APU shutdown, the de-oiling solenoid valve prevents the coking of the oil remaining in the bearing chambers.
Therefore the ECB opens the de-oiling solenoid valve during shut down between 90% and 7%



DE-OILING SOLENOID FUNCTION - DURING SHUT DOWN

APU AIR SYSTEM D/O (3)

APU RUNNING AT 100% - BLEED NOT SELECTED

Bleed air supply to the A/C pneumatic system is controlled by a bleed control valve for delivery function. The fuel-operated bleed control valve is a diverter valve: either to the A/C system and/or the Auxiliary Power Unit (APU) exhaust.

NOTE: the hydraulic fluid is high pressure fuel from the Fuel Control Unit pressure regulator part with a pressure of approximately 250 psig.

BLEED CONTROL

The quantity of air necessary for the aircraft bleed users is controlled by the opening angles of the load compressor Inlet Guide Vanes (IGVs). The IGVs are moved by a fuel-powered actuator.

SURGE PROTECTION

Load compressor surge protection is done by the bleed control valve that discharges the excess of air in the exhaust.

OIL COOLING

A gearbox-driven fan draws air from the inlet plenum and forces it to go through the oil cooler. After leaving the oil cooler, the air is discharged overboard. The cooling fan incorporates a Permanent Magnet Generator (PMG), which supplies a direct current to the Electronic Control Box (ECB), if the main supply is interrupted, for a maximum of 230ms.

COMPARTMENT COOLING

Air supplied by the fan, which is driven by one of the gears of the gearbox, is also used for the APU compartment cooling. The compartment cooling air is blown through a smaller duct attached to the fan discharge tube. Natural convection ventilates the APU compartment when the APU is not in operation.

PRESSURIZATION AND OIL VENT

Pressurized air enters the gearbox during operation from the front and rear bearing seal buffering systems. This air comes from the power section compressor. The gearbox is vented to the APU exhaust. The oil mist is separated from the vent air by an air-oil separator.

CONTROL

The ECB controls the air system using several parameters:
- signals from the APU inlet pressure and temperature sensor,
- signals from the load compressor discharge pressure sensor and the differential pressure sensor,
- command and feedback signals from the fuel driven actuators.

MONITORING

The compressor discharge pressure sensor is a unit, which contains a static pressure and a differential pressure sensor. It is located at the APU air intake plenum. The ECB uses the sensor output voltage for the calculation of the compressor air flow and to give the APU BLEED pressure indication for the APU page on the lower ECAM display unit. To help maintenance and troubleshooting, the bleed control valve has a visual position indicator.

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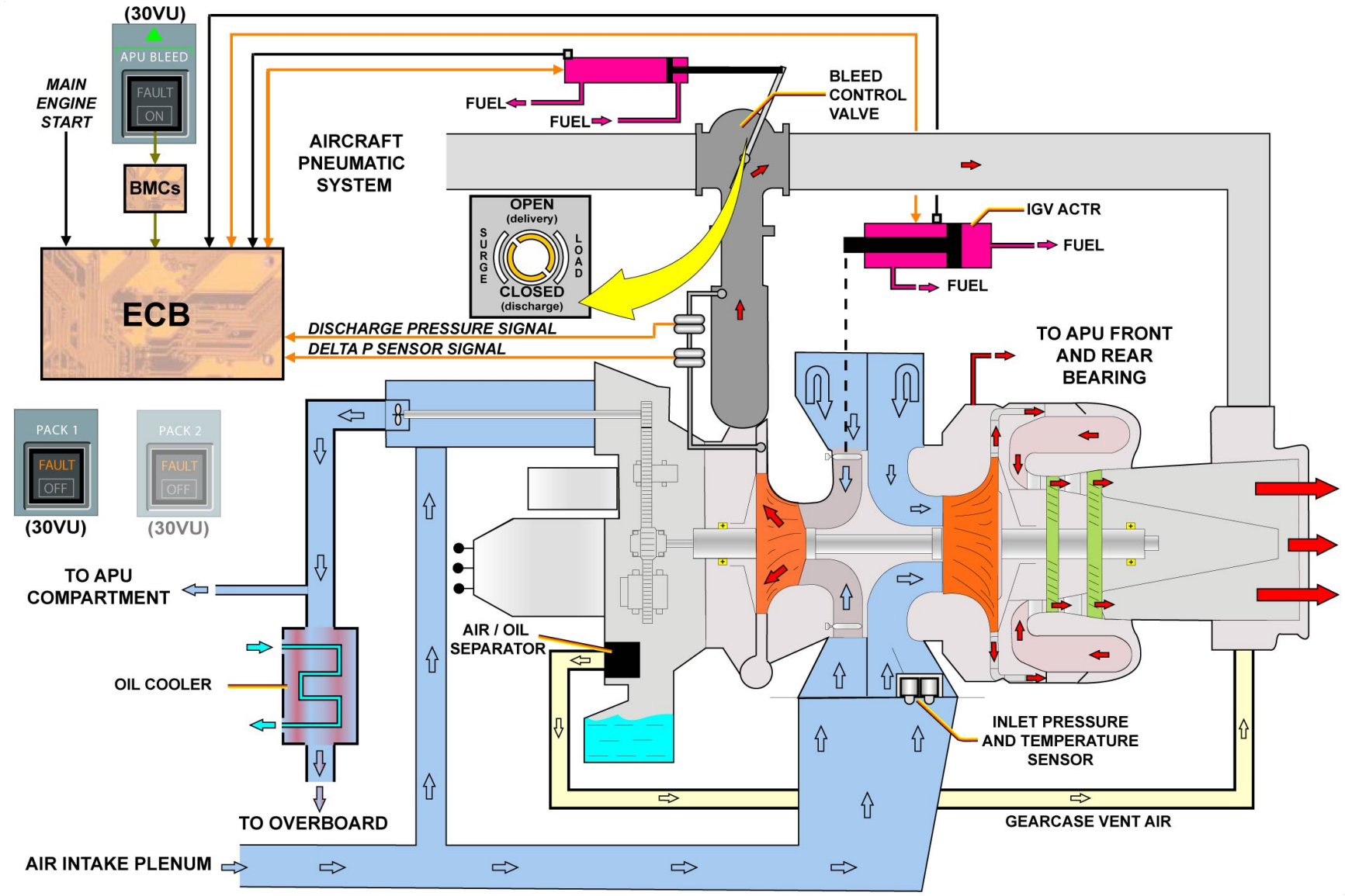

APU RUNNING AT 100% - BLEED NOT SELECTED - BLEED CONTROL ... MONITORING

APU AIR SYSTEM D/O (3)

APU RUNNING AT 100% - BLEED PUSHBUTTON ON

When the APU Bleed P/B is pushed, the blue ON light in the P/B comes on and a signal is sent to the two BMCs and to the ECB to open the Bleed Control Valve (BCV).
The BCV servo valve receives a command signal from the ECB to let the BCV open the duct for Aircraft Pneumatic System supply and to let bleed air flow into the supply duct.
To make sure that a pressure build-up occurs in the Aircraft Bleed supply duct, the ECB first commands the Bleed Control Valve (BCV) to the exhaust duct closed position and then modulates the BCV to prevent surge conditions.
The BCV uses an LVDT for position feedback transmission to the ECB.

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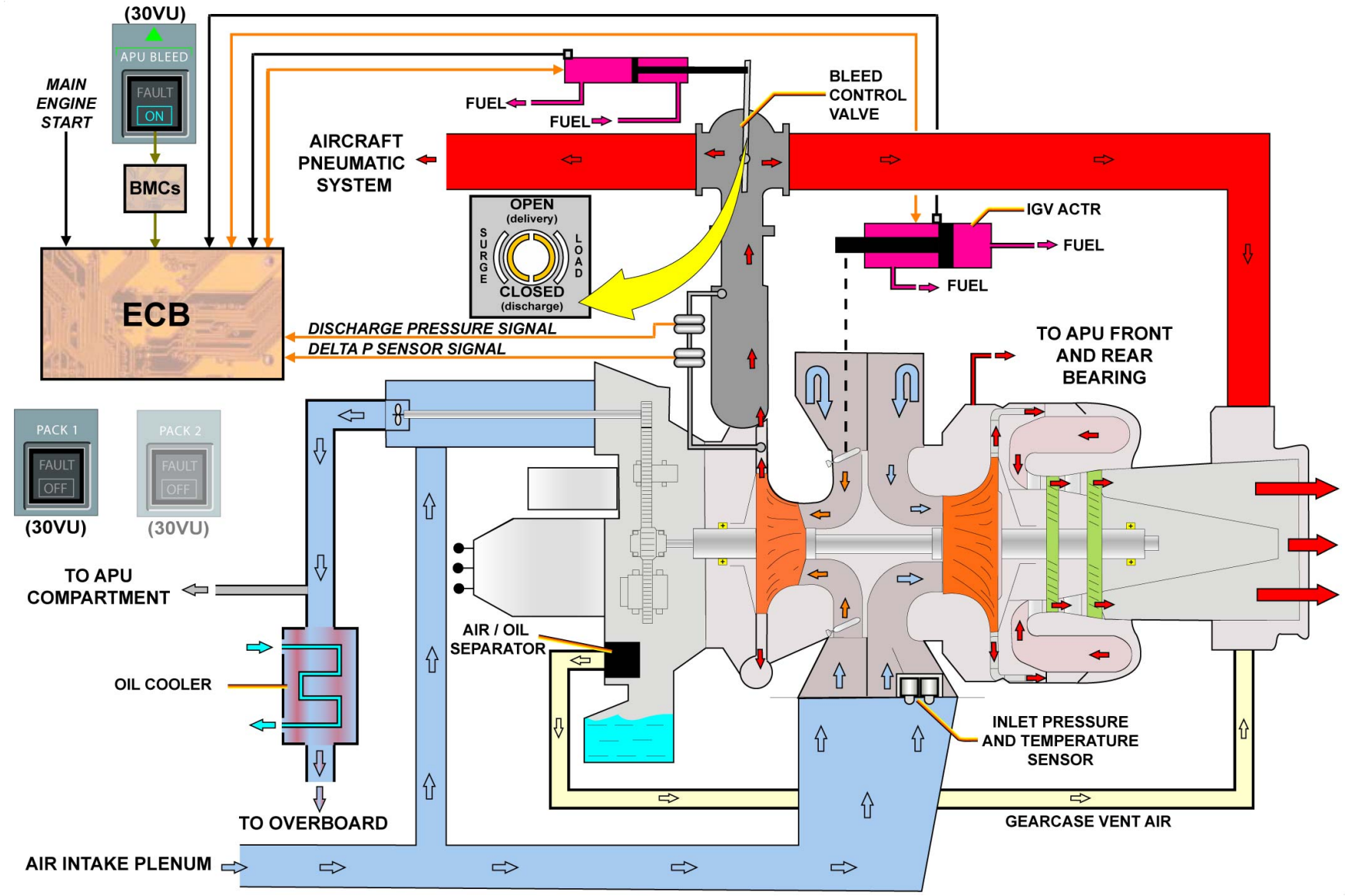


APU RUNNING AT 100% - BLEED PUSHBUTTON ON

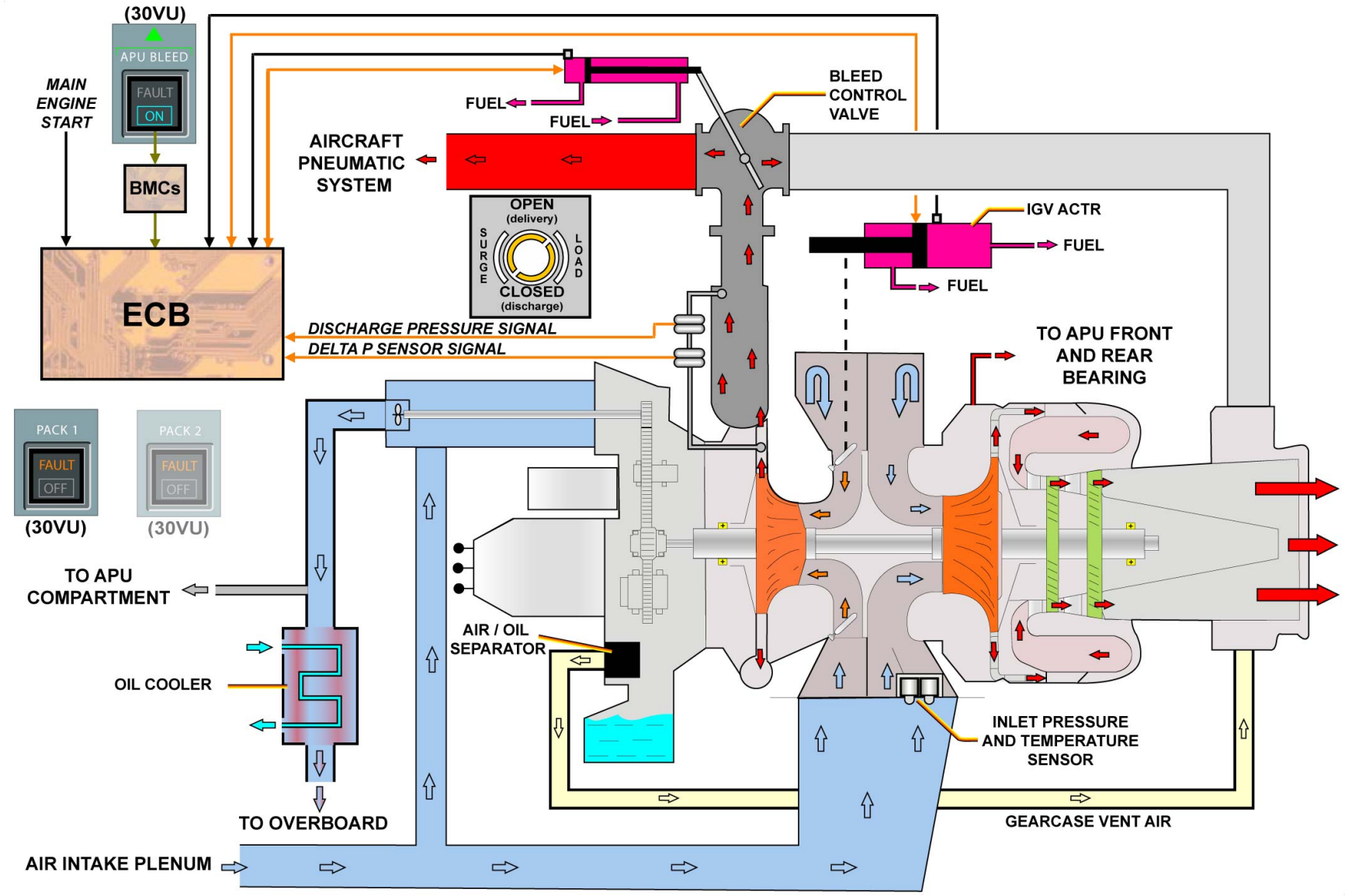
UGB13131 - U7ST0M0 - UM49D600000003

APU AIR SYSTEM D/O (3)

APU RUNNING AT 100% - BLEED AND PACK PUSHBUTTON PUSHED

The ECB receives a command signal from the ECS Control Computer after the Pack P/B is pushed on the Cockpit overhead panel.
Because of this input signal, the ECB sends an extend command signal to the IGV-Actuator to drive the Inlet Guide Vanes into a more open position.
Because of this, more air from the APU Inlet Plenum will go through the IGVs into the Load Compressor Housing.
To make sure that the necessary bleed air mass flows from the APU to the ECS, the ECB commands the BCV to the exhaust duct fully closed position.

UGB13131 - U7ST0M0 - UM49D600000003



APU RUNNING AT 100% - BLEED AND PACK PUSHBUTTON PUSHED

UGB13131 - U7ST0M0 - UM49D600000003

APU AIR SYSTEM D/O (3)

APU RUNNING AT 100% - BLEED AND MES SIGNAL INPUT TO ECB

When the engines of the aircaft are started, the ECB receives a Main Engine Start (MES) boost signal to increase the bleed pressure for engine start.
The ECB commands the IGV Actuator to the maximum extended position to drive the IGVs to the fully open position.
The BCV receives the command signal from the ECB to modulate and discharge a certain mass of air into the APU exhaust.
When the engine start sequence is completed, the MES signal is no longer applicable and the ECB commands the IGV actuator and the BCV to the necessary position for bleed supply of the ECS.

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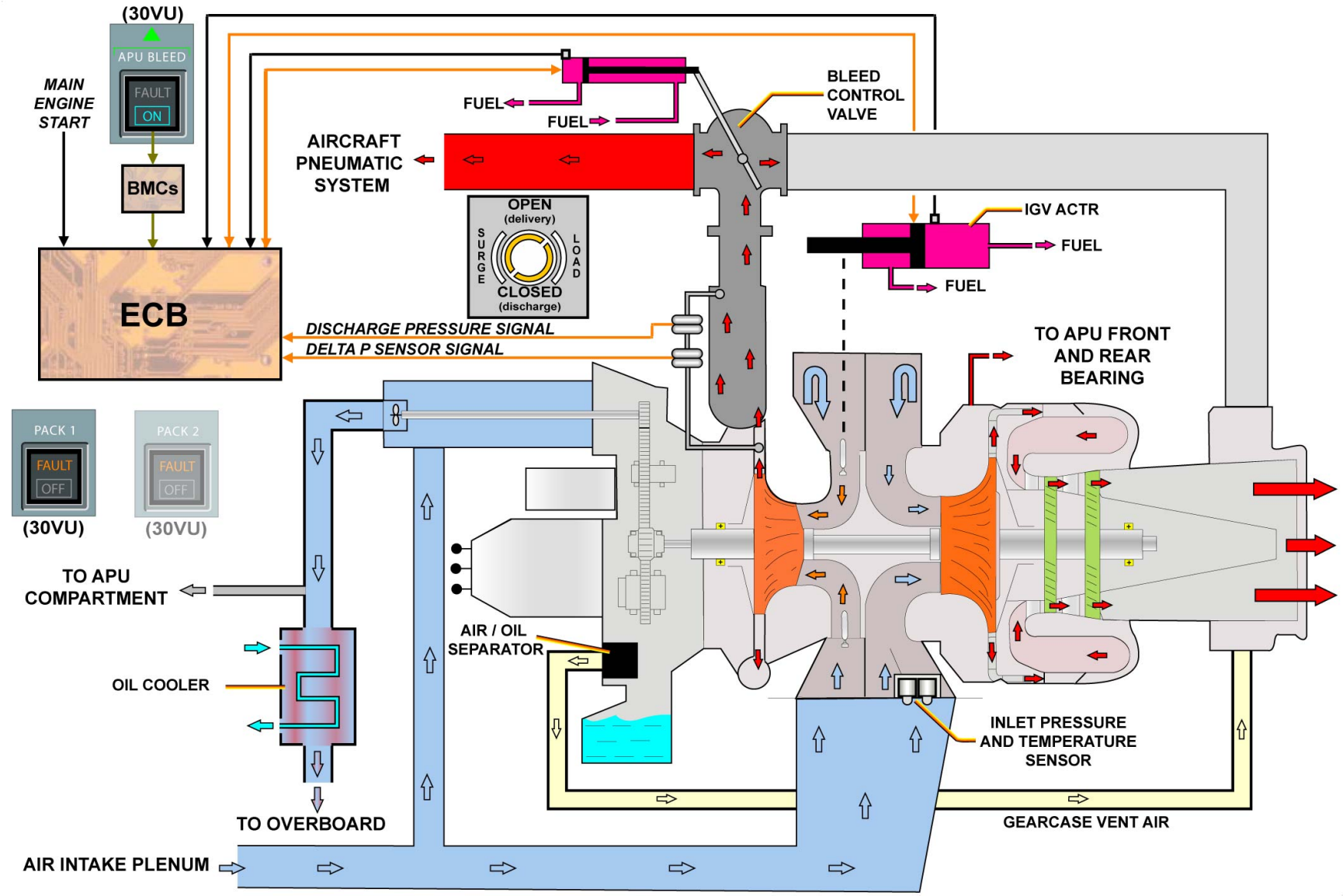

APU RUNNING AT 100% - BLEED AND MES SIGNAL INPUT TO ECB

APU SYSTEM MANAGEMENT D/O (3)

GENERAL

The Auxiliary Power Unit (APU) system management and control keeps the APU rotation speed constant to obtain a constant AC generator frequency output, protects the power unit from over temperature, avoids load compressor surge, controls safe APU start and eases the APU maintenance. The APU management system controls the following sequences:

- power-up state,
- watch state,
- starting state,
- steady state,
- cool down state,
- shutdown sate.

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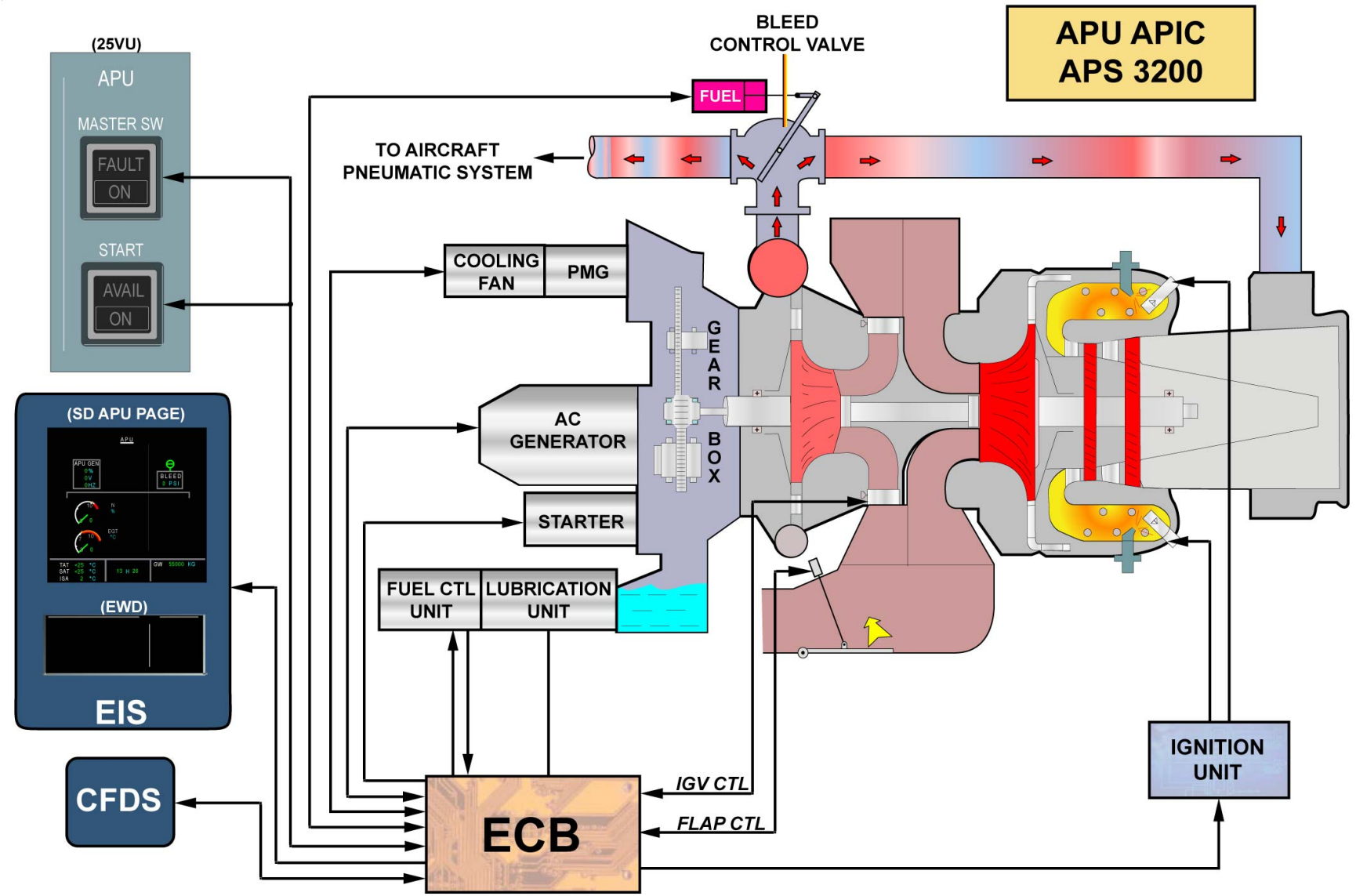

APU APIC
APS 3200
BLEED
CONTROL VALVE
FUEL
TO AIRCRAFT
PNEUMATIC SYSTEM
(25VU)
APU
MASTER SW
FAULT
ON
START
AVAIL
ON
COOLING
FAN
PMG
GEAR
BOX
AC
GENERATOR
STARTER
FUEL CTL
UNIT
LUBRICATION
UNIT
(SD APU PAGE)
(EWD)
EIS
CFDS
ECB
IGV CTL
FLAP CTL
IGNITION
UNIT

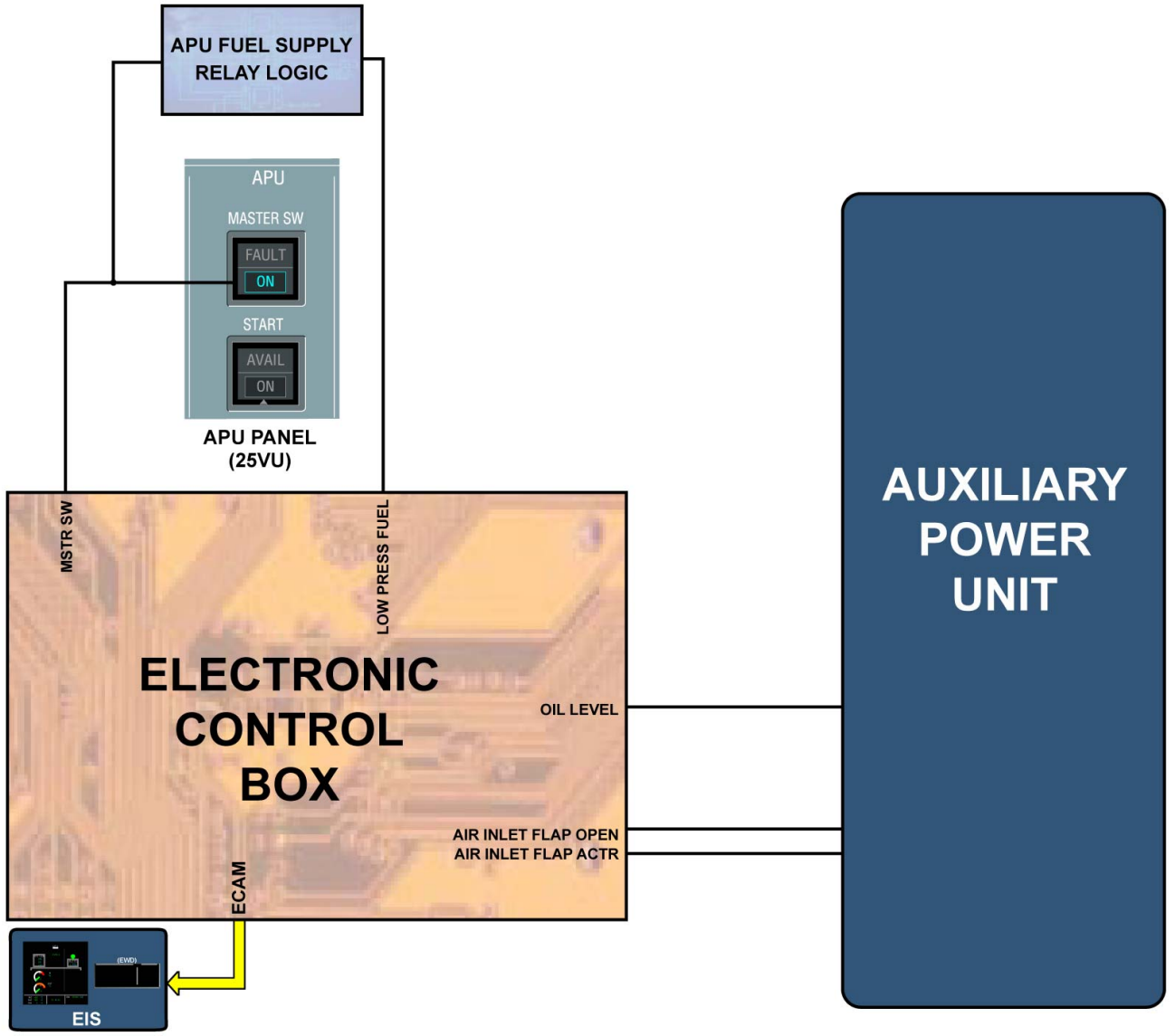
GENERAL

APU SYSTEM MANAGEMENT D/O (3)

POWER-UP STATE

When the APU MASTER SWitch is set to ON, the APU fuel Low Pressure (LP) valve opens and the APU fuel pump logic is energized. The Electronic Control Box (ECB) controls the opening of the air intake flap and initiates a power-up test:
- test of On Board Replaceable Module (OBRM), Read Only Memory (ROM) checksum, Random Access Memory (RAM) read/write,
- test of speed circuit, oil level, discrete and analog outputs,
- on the lower ECAM display unit the APU page is shown.

UGB13131 - U7ST0M0 - UM49D7000000003



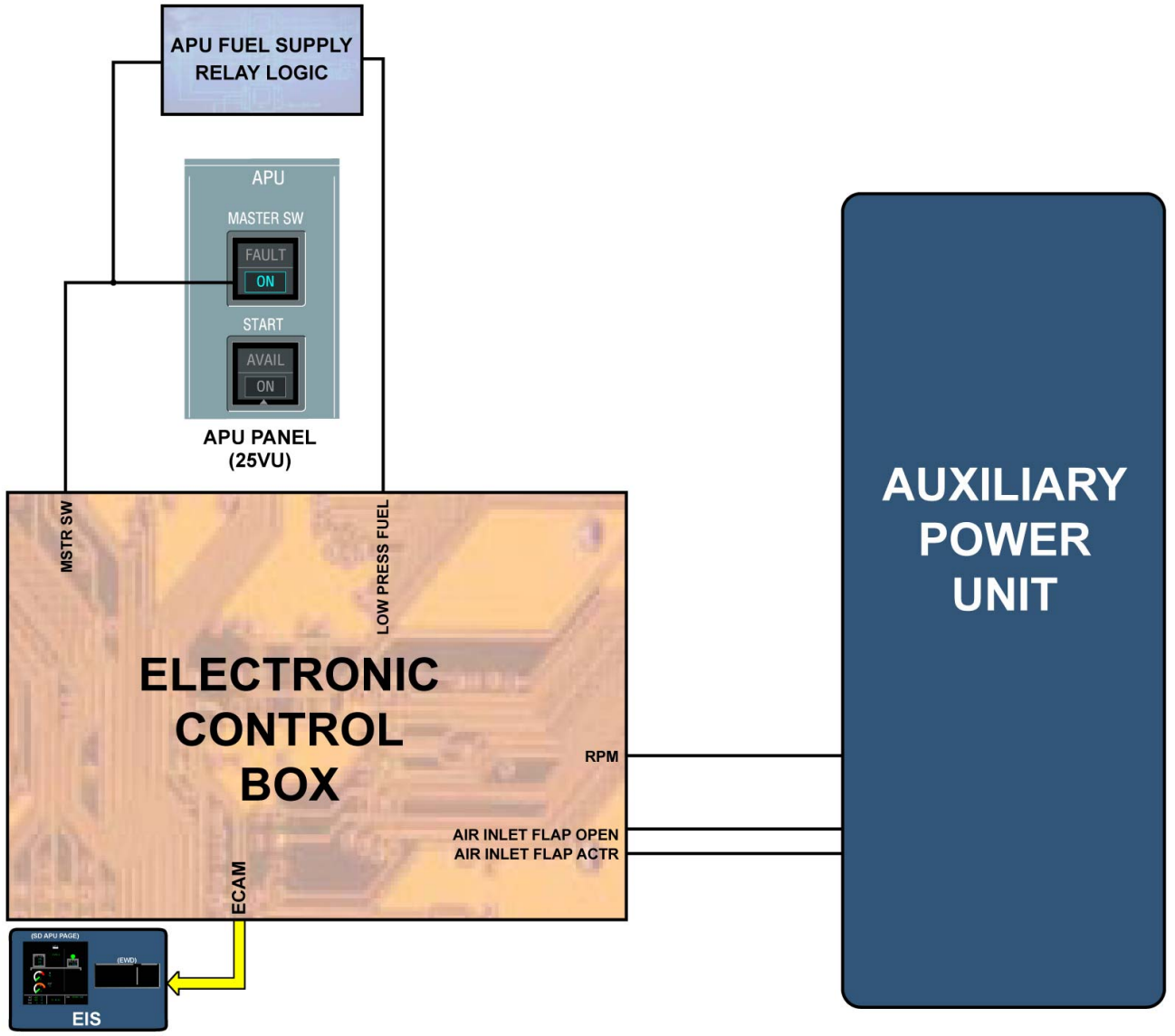
POWER-UP STATE

APU SYSTEM MANAGEMENT D/O (3)

WATCH AND START PREPARATION STATE

After completion of the power-up state, the ECB automatically enters the watch state. Upon receipt of the start command, provided that there are no prohibitive conditions and rotation speed is less than or equal to 7% rpm, the ECB enters the start preparation state.

UGB13131 - U7ST0M0 - UM49D7000000003



WATCH AND START PREPARATION STATE

APU SYSTEM MANAGEMENT D/O (3)

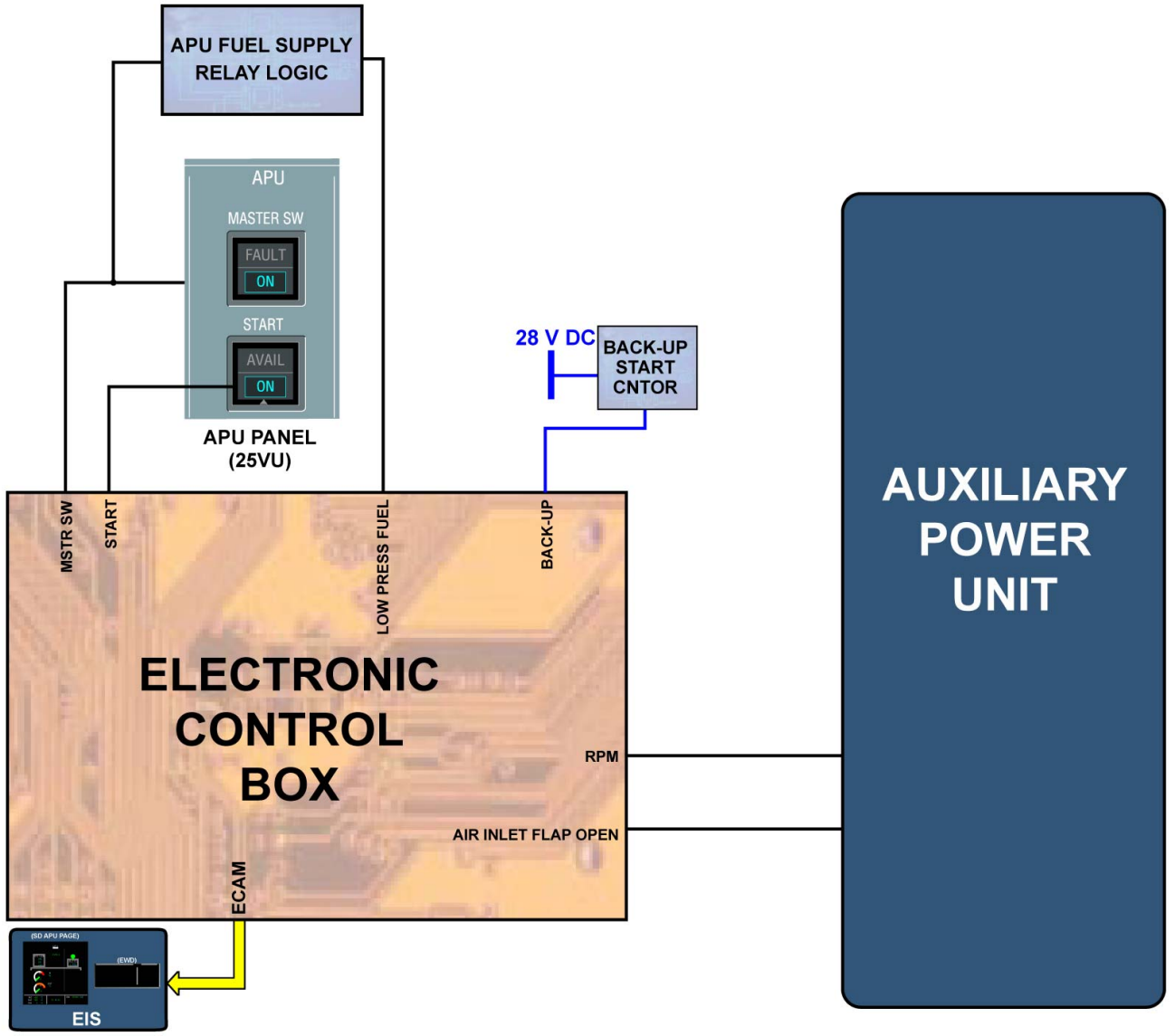
STARTING STATE

The starting state begins when the APU START P/BSW is pressed and continues until APU AVAILable light activation.

START P/B PRESSED + 100 MS

When the START P/BSW has been pressed in, the ECB initiates the start sequence and energizes the backup start contactor. The receipt of a stop signal at any time during the starting state leads to a shutdown without any cool down period.

UGB13131 - U7ST0M0 - UM49D7000000003



STARTING STATE - START P/B PRESSED + 100 MS

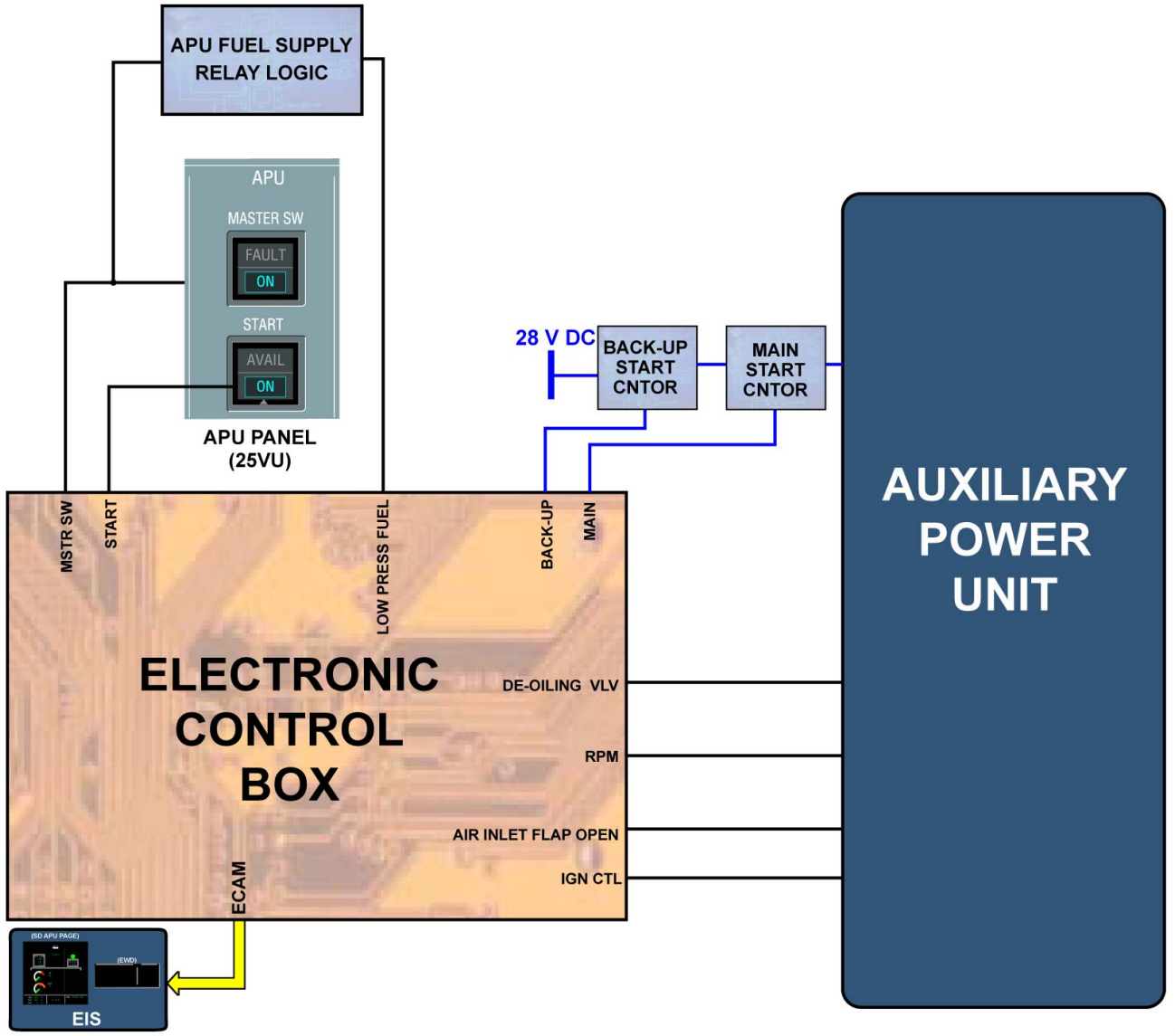
APU SYSTEM MANAGEMENT D/O (3)

STARTING STATE (continued)

BACKUP START CONTACTOR SUPPLIED + 1.5 S

The components activated by the ECB are:
- the gearbox de-oiling valve,
- the ignition unit,
- the main start contactor.

UGB13131 - U7ST0M0 - UM49D7000000003



STARTING STATE - BACKUP START CONTACTOR SUPPLIED + 1.5 S

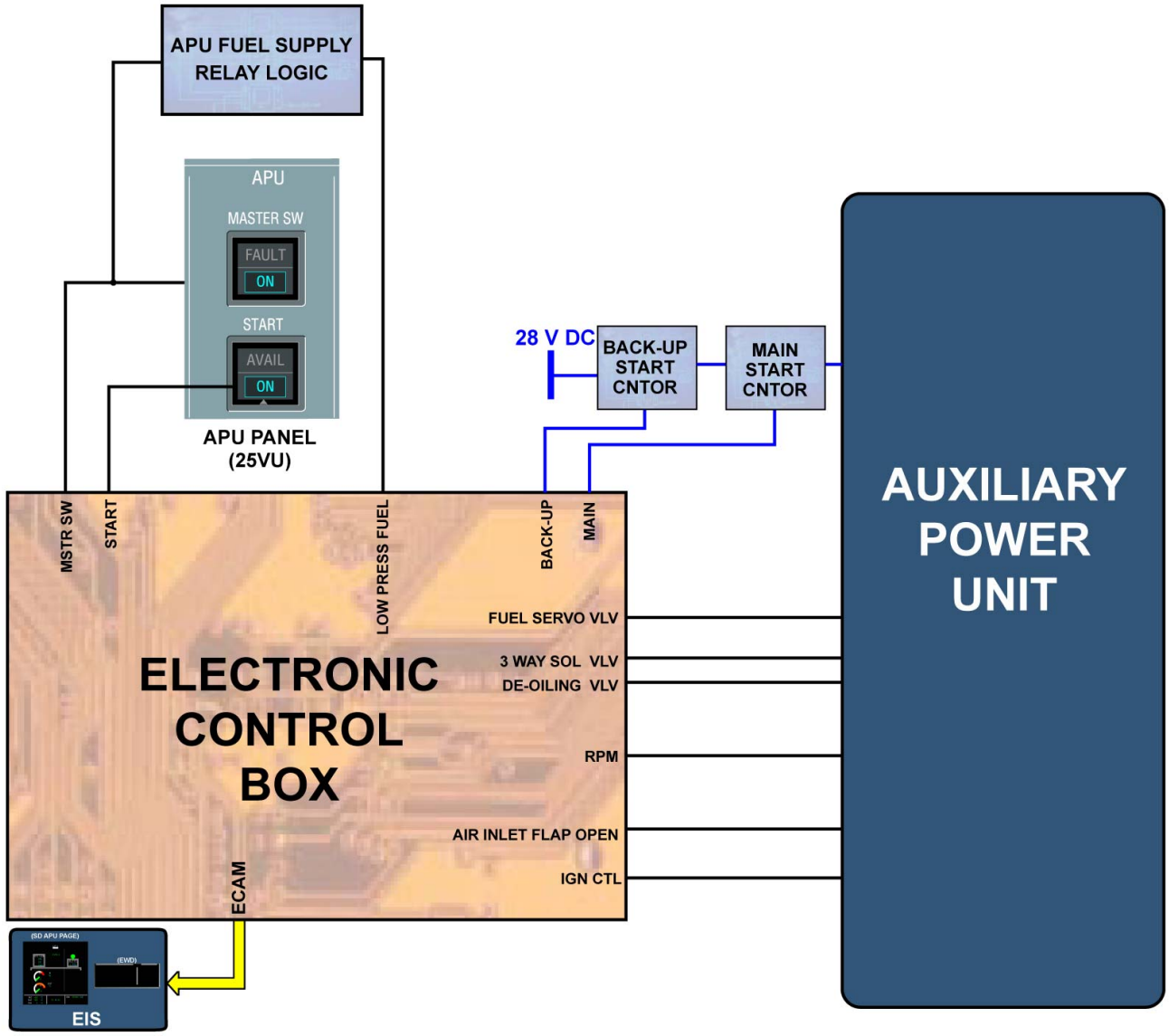
APU SYSTEM MANAGEMENT D/O (3)

STARTING STATE (continued)

ROTATION SPEED N > 3% RPM

The components activated by the ECB are:
- the 3-way solenoid valve for the High Pressure (HP) fuel ON/OFF function,
- the fuel servovalve for the fuel metering function.

UGB13131 - U7ST0M0 - UM49D7000000003



STARTING STATE - ROTATION SPEED N > 3% RPM

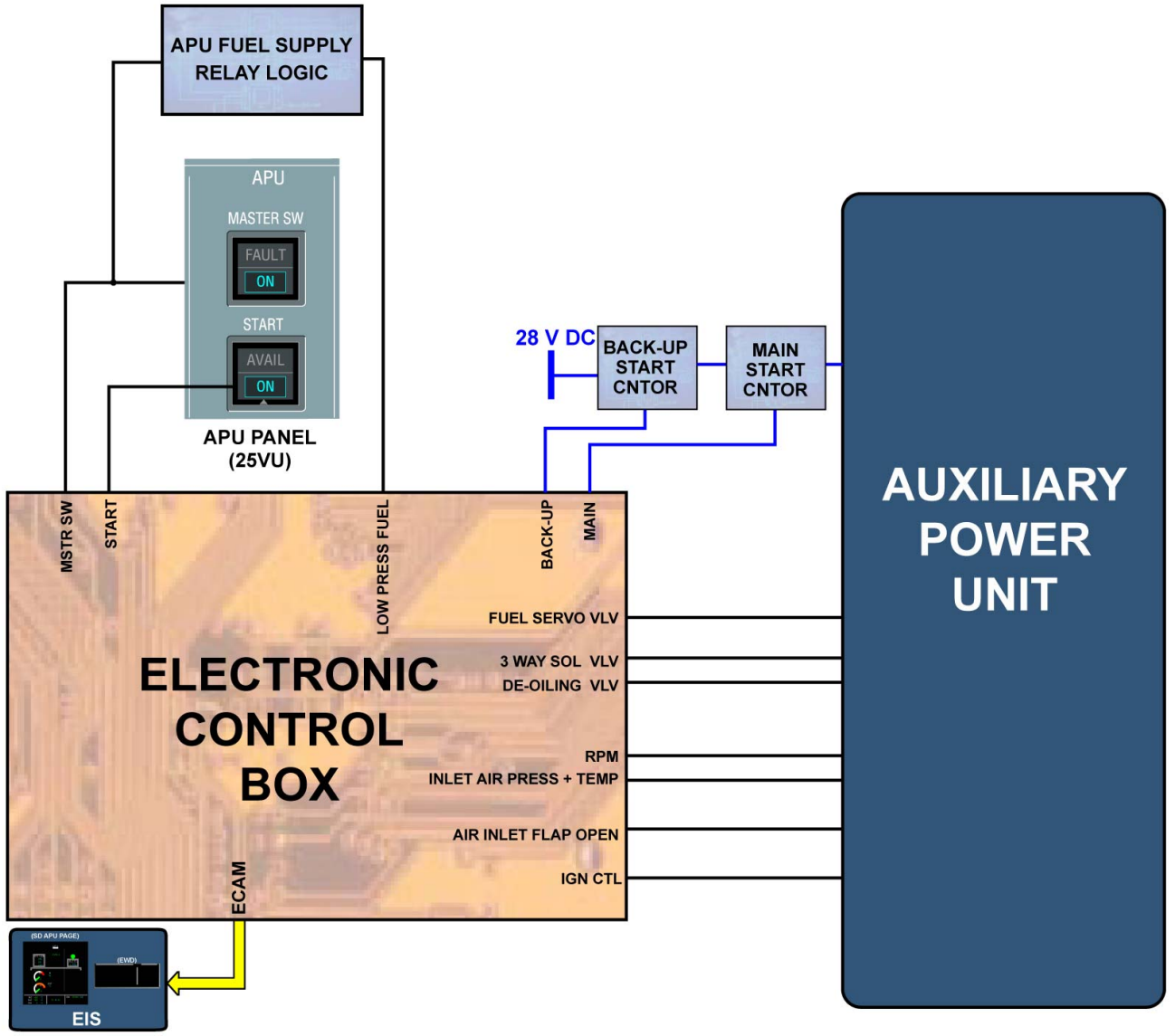
APU SYSTEM MANAGEMENT D/O (3)

STARTING STATE (continued)

ROTATION SPEED N > 5% RPM

During starting, fuel flow is controlled under the following programs:
- begin manifold fill algorithm,
- open loop fuel schedule.

UGB13131 - U7ST0M0 - UM49D7000000003



STARTING STATE - ROTATION SPEED N > 5% RPM

APU SYSTEM MANAGEMENT D/O (3)

STARTING STATE (continued)

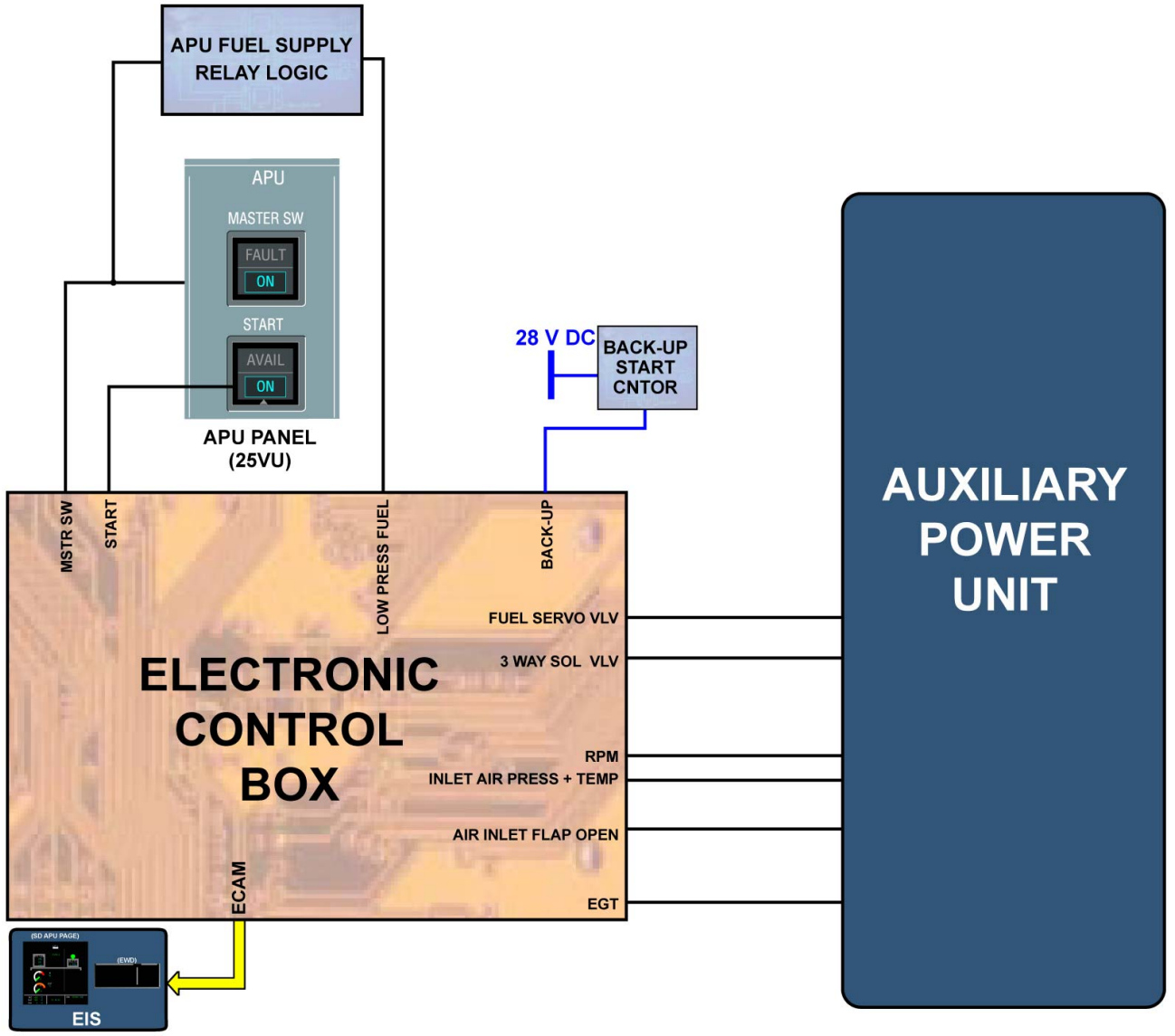
DELTA EGT > 10°C

The initiated acceleration is controlled to 100% rpm.

ROTATION SPEED N > 55% RPM

The ECB de-energizes:
- the ignition unit,
- the gearbox de-oiling valve,
- the main start contactor.

UGB13131 - U7ST0M0 - UM49D7000000003



STARTING STATE - DELTA EGT > 10°C & ROTATION SPEED N > 55% RPM

APU SYSTEM MANAGEMENT D/O (3)

STARTING STATE (continued)

ROTATION SPEED N > 55% RPM + 5 S

The backup start contactor is de-energized.

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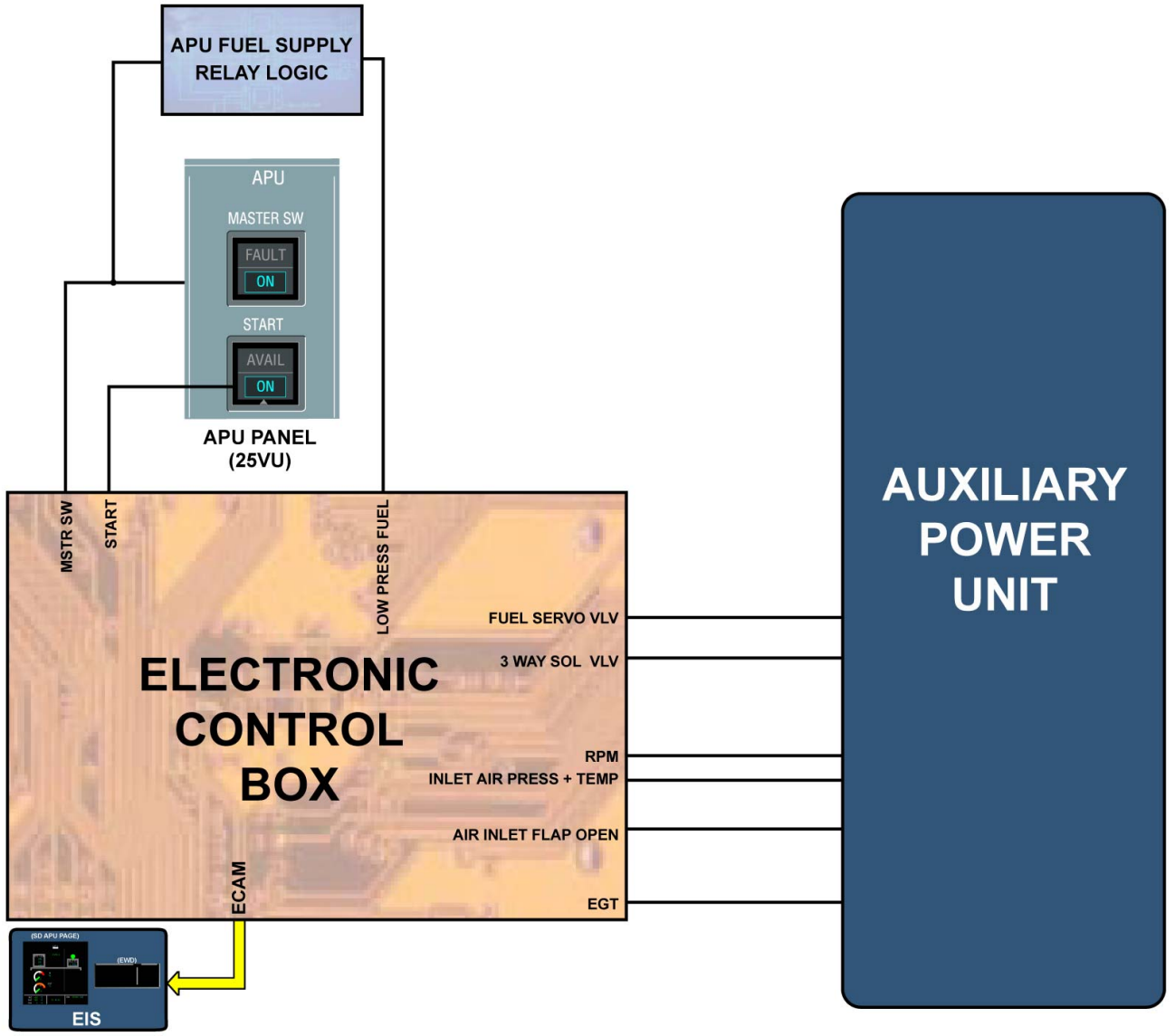


STARTING STATE - ROTATION SPEED N > 55% RPM + 5 S

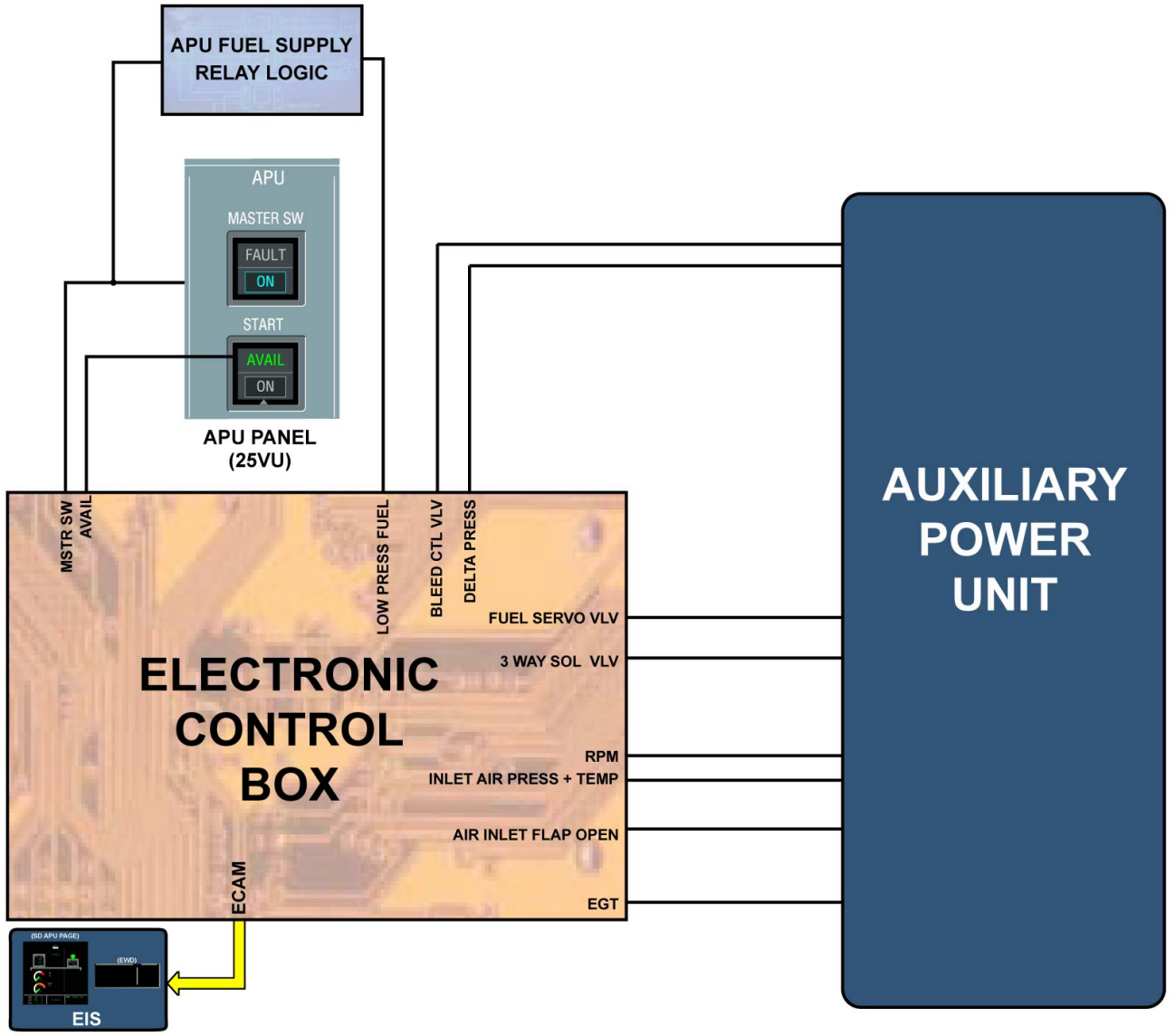
APU SYSTEM MANAGEMENT D/O (3)

STARTING STATE (continued)

ROTATION SPEED N > 95% RPM

The ECB functions are:
- surge control and IGV control loops activation,
- APU AVAIL signal activation,
- start in progress output de-activation,
- steady state speed control loop activation,
- enter run state.

UGB13131 - U7ST0M0 - UM49D7000000003



STARTING STATE - ROTATION SPEED N > 95% RPM

APU SYSTEM MANAGEMENT D/O (3)

STEADY STATE

In steady state the ECB controls the speed, the load compressor operation, and monitors the Exhaust Gas Temperature (EGT).

SPEED CONTROL

This function keeps the rotation speed of the APU rotating assembly constant, whatever the load applied. This is achieved by metering the fuel flow, which varies with the air inlet pressure and temperature.

LOAD COMPRESSOR CONTROL

This function opens the Inlet Guide Vanes (IGVs) according to the bleed air demand from the A/C, ECS or MES. Protection against load compressor surge is achieved by controlling and reading the position of the bleed control valve, according to the inlet temperature, and differential and discharge pressure signals of the load compressor (DELTA P/P ratio). If the ECB detects a surge condition, the bleed control valve is positioned to discharge air to the exhaust.

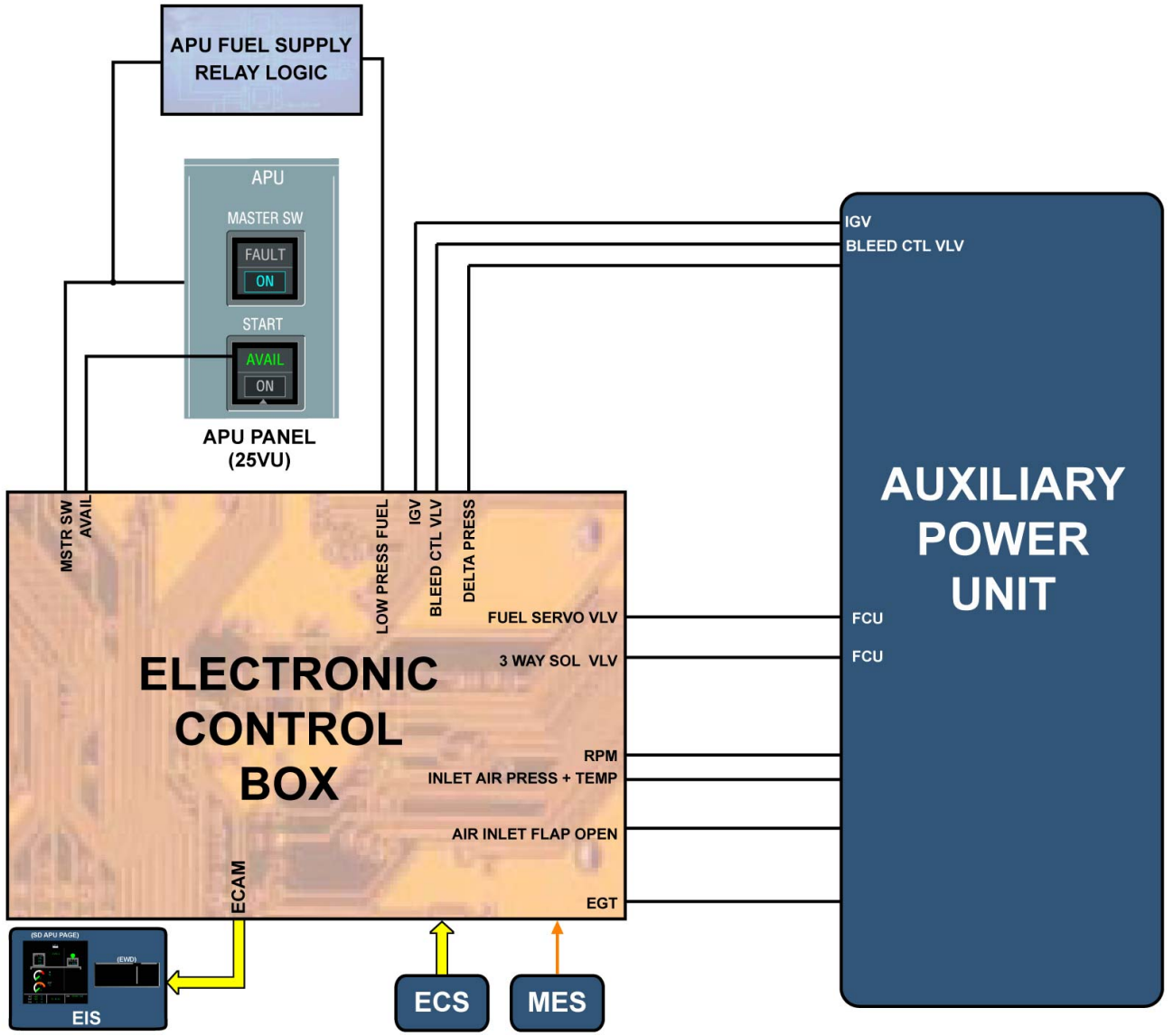
NOTE: 1: In case of failure of the load compressor control, the IGVs are closed and the bleed control valve is fully opened to discharge.
2: In case of detected reverse flow operation, the APU is automatically shut down by the ECB.

EGT CONTROL

This function avoids APU over temperature by controlling the Inlet Guide Vane (IGV) position to closed. Thus, the pneumatic load is first reduced to give priority to the electrical load. This is achieved by controlling the position of the IGVs to the closed position as a function of the EGT as long as the over temperature condition is present.

NOTE: In case of IGV control failure, the IGVs are closed.

UGB13131 - U7ST0M0 - UM49D7000000003



STEADY STATE - SPEED CONTROL ... EGT CONTROL

APU SYSTEM MANAGEMENT D/O (3)

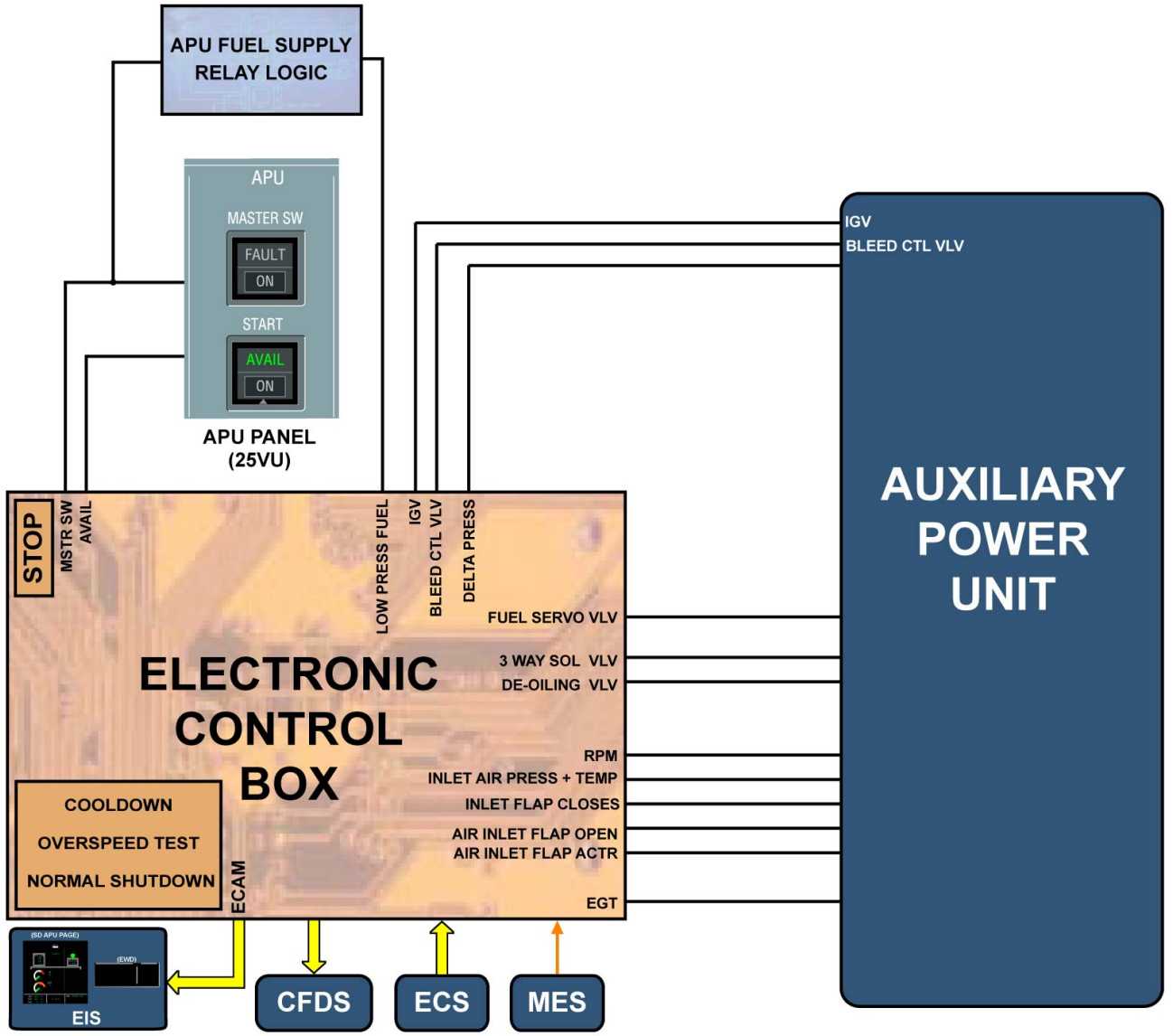
COOLDOWN STATE

At stop command MASTER SW OFF, the pneumatic load is removed, i.e. the IGVs are closed, the bleed control valve positioned to discharge, the AC generator may still be loaded, then the engine goes into a 120 s cool down cycles. This function runs the APU at a low stabilized temperature before normal shutdown.

NORMAL SHUTDOWN

An APU normal shutdown is initiated when the MASTER SW P/B is released out. If the APU bleed air is not selected, the APU shuts down immediately. The normal shutdown signal stops the fuel supply. This causes the APU to decelerate. The AVAIL indication goes off and the AC generator de-energizes. When the speed is less than 90% rpm, the gearbox de-oil solenoid valve opens. When the speed is less than 7% rpm, the air intake flap is controlled to fully close and the de-oiling solenoid valve is de-energized to close.

UGB13131 - U7ST0M0 - UM49D7000000003



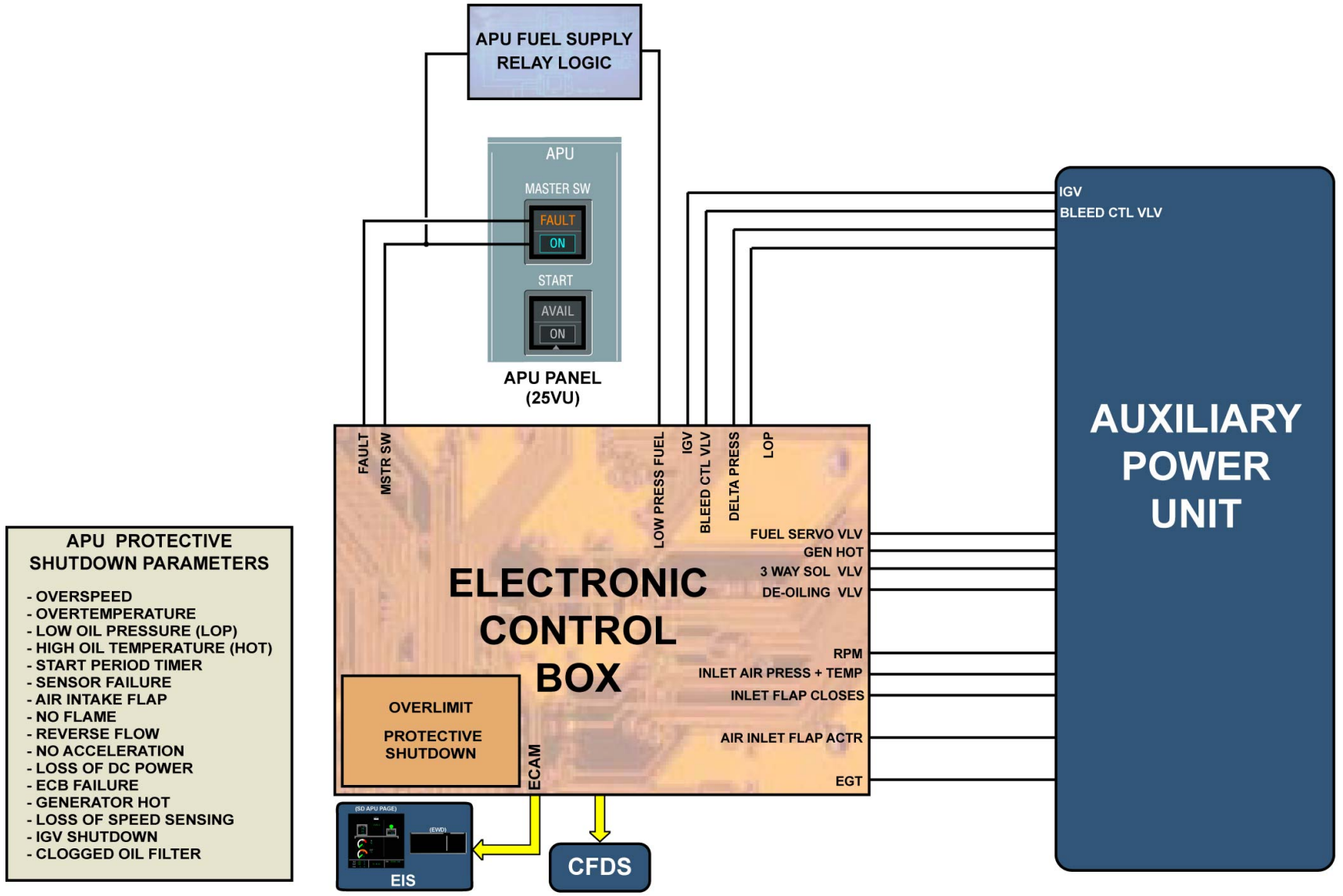
COOLDOWN STATE & NORMAL SHUTDOWN

APU SYSTEM MANAGEMENT D/O (3)

PROTECTIVE SHUTDOWN

When the ECB is powered, it controls the APU starting and running phases. If an abnormal parameter is detected, it initiates an immediate shutdown without time delay, even if the APU bleed air system is used.
The ECB protective shutdown parameters are:
- over speed,
- over temperature
- Low Oil Pressure (LOP),
- High Oil Temperature (HOT),
- start period timer,
- sensor failure,
- air intake flap,
- no flame,
- reverse flow,
- no acceleration,
- loss of DC power,
- ECB failure,
- generator HOT
- loss of speed sensing,
- IGV shutdown,
- oil filter clogged.

UGB13131 - U7ST0M0 - UM49D7000000003



PROTECTIVE SHUTDOWN

APU SYSTEM MANAGEMENT D/O (3)

EMERGENCY SHUTDOWN

The ECB initiates an emergency shutdown when either the APU FIRE P/B, which is located in the cockpit, is released out, or when the APU SHUT OFF pushbutton, which is located on the external power receptacle panel, is pressed. The ECB receives automatically an emergency shutdown signal when an APU FIRE is detected on ground by the APU Fire Detection Unit. The APU shuts down immediately without time delay, even if the APU bleed air system is used.

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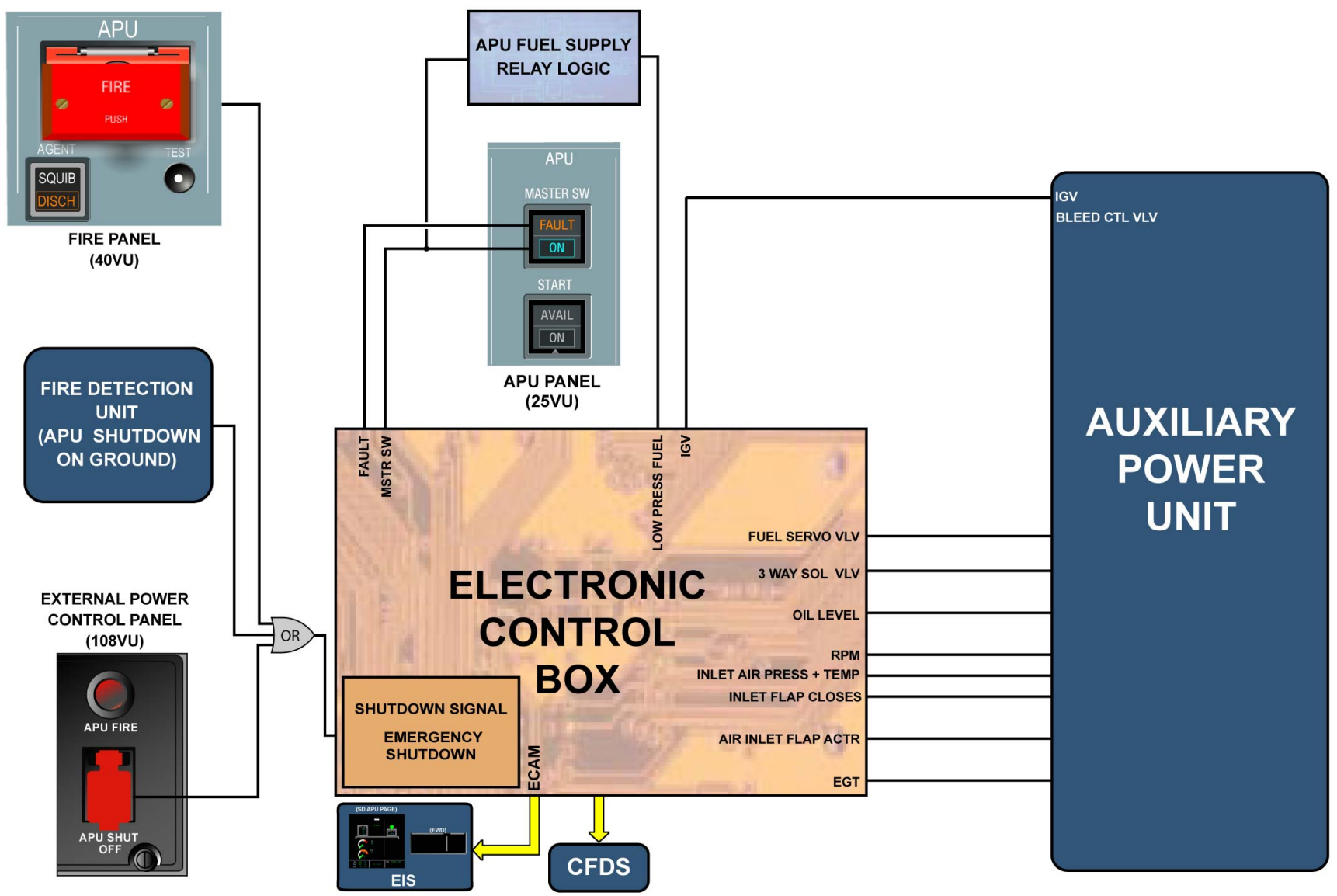

EMERGENCY SHUTDOWN

ECB INTERFACES (3)

POWER SUPPLY

The Electronic Control Box (ECB) is electrically supplied, through the Auxiliary Power Unit (APU) MAIN control relay, by at least one of the A/C batteries, the A/C DC network or transiently from the 28 V DC Permanent Magnet Generator (PMG).

MASTER SWITCH P/B

The APU MASTER SWitch sends a discrete supply or stop signal to the ECB. The ECB sends a discrete signal to the FAULT light when an automatic or emergency shutdown occurs or a power-up test fails.

AIR INTAKE FLAP

The ECB sends a power output for opening or closing the air intake flap and receives an air intake flap open or closed position signal.

START P/B

A discrete input signal from the START P/B initiates the starting sequences. The ECB sends a discrete signal to the ON light during the APU start sequence. A discrete output signal to the A/C energizes the AVAIL light in the START P/B when the APU speed is above 95% rpm.

BACK-UP AND MAIN START CONTACTORS

The ECB sends discrete output signals to the back-up and the main start contactors and receives as a feedback a discrete input from the main start contactor.

EMERGENCY STOP

A discrete input signal from the A/C initiates the APU emergency shutdown logic after the ECB has received this signal.

LGCIU 1

The ECB receives the flight/ground discrete input signal from the Landing Gear Control and Interface Unit (LGCIU) 1.

APU FUEL FEED SYSTEM

The ECB receives a discrete signal from the APU low fuel pressure switch. It sends a discrete signal to the APU fuel LP Shut-Off Valve (SOV).

EIU

During engine starts, the ECB receives a Main Engine Start (MES) signal from Engine Interface Units (EIUs) 1 or 2. This signal causes the ECB to position the Inlet Guide Vanes (IGVs) to the fully open position and the bleed control valve to modulate in delivery position.

BMC

When the APU bleed P/B is set to ON, Bleed Monitoring Computers (BMCs) 1 or 2 send a discrete input to the ECB which controls the opening of the APU bleed control valve. ECB sends discrete output signal to the BMCs to indicate when the BCV is not in the closed position.

TSO/JAR

The ECB receives a discrete input from the A/C signature PIN programming. This open or ground signal determines whether the ECB follows the Technical Standard Order (TSO) or the Joint Aviation Requirements (JAR).

ENVIRONMENTAL CONTROL SYSTEM (ECS)

The ECB receives, via an ARINC 429 bus, an input from the Air conditioning System Controller 1 and 2 (ACSC) to control the IGVs

UGB13131 - U7ST0M0 - UM49F1000000006

position according to the demand. The ECB sends a discrete output to the ACSC 1 and 2 to signal that the APU bleed valve is in delivery position.

A320/A321 IDENTIFICATION

The ECB receives a discrete input from the A/C signature PIN programming. This identification PIN lets the ECB identify the A321 applications for functional differences from those of an A320.

GENERATOR OIL TEMPERATURE SENSOR

The ECB receives an analog input from this sensor which is a component mounted on the AC generator.

SDAC

The ECB sends to the System Data Acquisition Concentrators (SDACs) 1 and 2, via ARINC 429 data buses, the indications to show on the ECAM APU page and shutdown information to trigger the related warnings.

CFDS

The ECB is a BITE type 1 computer and is connected to the Centralized Fault Display System (CFDS) via ARINC 429 data buses.

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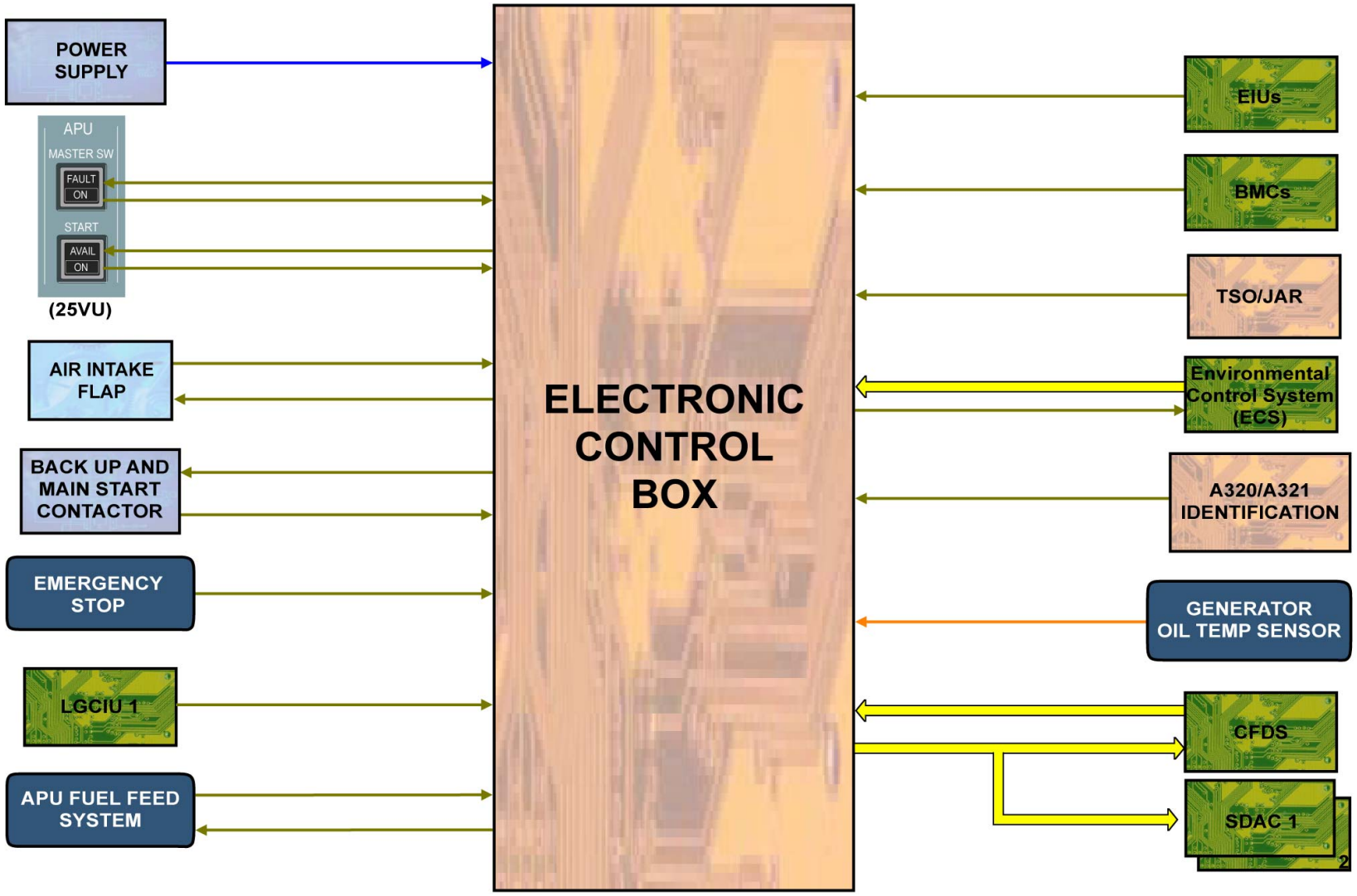

POWER SUPPLY ... CFDS

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APU SYSTEM OPERATION, CONTROL & INDICATING (3)

AUTO SHUT-DOWN

EMERGENCY SHUT-DOWN

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UGB13131 - U7ST0M0 - UM49IZLEVEL0302

COMPT ACCESS DOORS OPENING & CLOSING (2)

WARNING

WARNING: DO NOT TOUCH THE AUXILIARY POWER UNIT (APU) UNTIL IT IS SUFFICIENTLY COOL TO PREVENT BURNS WHEN YOU DO THE MAINTENANCE TASK. MAKE SURE THAT THE THREE QUICK RELEASE FASTENERS ON THE APU LEFT ACCESS DOOR ARE CORRECTLY STOWED. THIS PREVENTS DAMAGE TO THE SEAL ON THE APU LEFT ACCESS DOOR.

UGB13131 - U7ST0M0 - UM49Y1000000001

WARNING
DO NOT TOUCH THE APU
UNTIL IT IS SUFFICIENTLY COOL
MAKE SURE THAT THE THREE QUICK
RELEASE FASTENERS ON THE APU LEFT
ACCESS DOOR ARE CORRECTLY STOWED

WARNING

COMPT ACCESS DOORS OPENING & CLOSING (2)

APU ACCESS DOORS OPENING PROCEDURE

Before working on the APU, some precautions have to be taken in the Cockpit :
- on the Overhead Panel 25 VU, put a warning notice to tell people not to start the APU.
- on Panel 121 VU, open, safety and tag the Circuit Breakers.

To open the APU Access door, start with the three latches at the bottom of the door.
Push the snapper and pull the latch handle to open the three latches.
Hold the door and release the two latches of the shoot bolts at the both ends of the door.
Release the door and leave them in the vertical position.
Release the pip-pin and pull the end of the telescopic strut out until it locks.
Push the door further open and attach the telescopic strut with the pip-pin to the fuselage attach point.
Open the other APU access door and release the two latches of the shoot bolts at the end of the APU Access.
Take the handle to move the access door into the vertical position . After that push the handle outboard to move the access door in the over center position.

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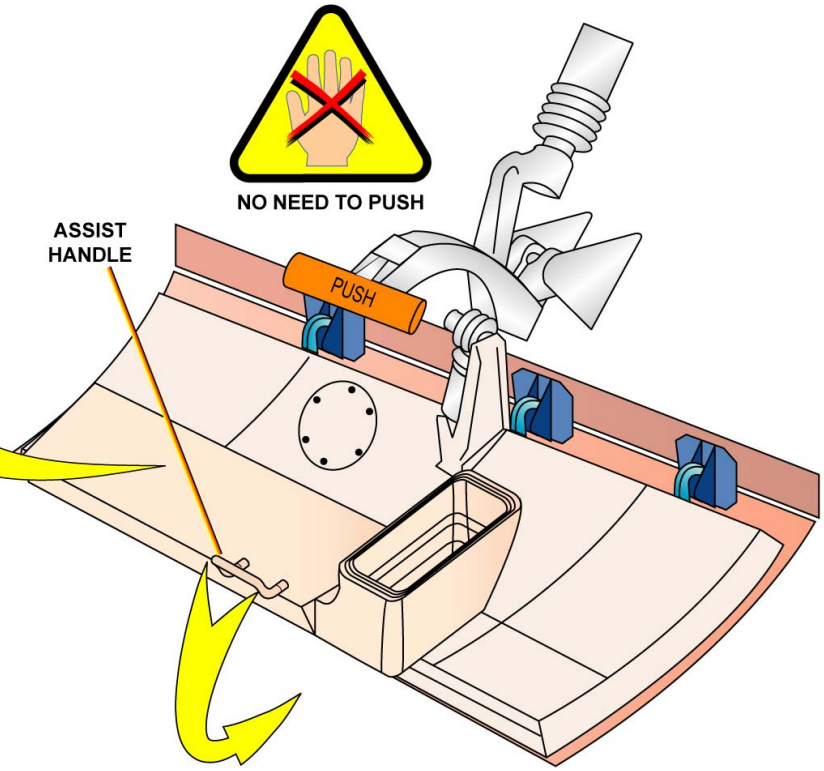

APU ACCESS DOORS OPENING PROCEDURE

COMPT ACCESS DOORS OPENING & CLOSING (2)

APU ACCESS DOORS CLOSING PROCEDURE

Push the handle and the control handle outboard and release the access door from the over center position.
Pull the handle to move the access door to the closed position and operate the two shoot-bolt latches.
Hold the access door and release the pip-pin from the fuselage attach point.
Push the knurled grip back and move the telescopic strut to the closed position. Lock the telescopic strut to the door attach point.
Close the access door and lock it with the two shoot bolts.
At the bottom of the doors, lock the three latches.
Remove the Safety Precaution and the tags from the circuit breakers.

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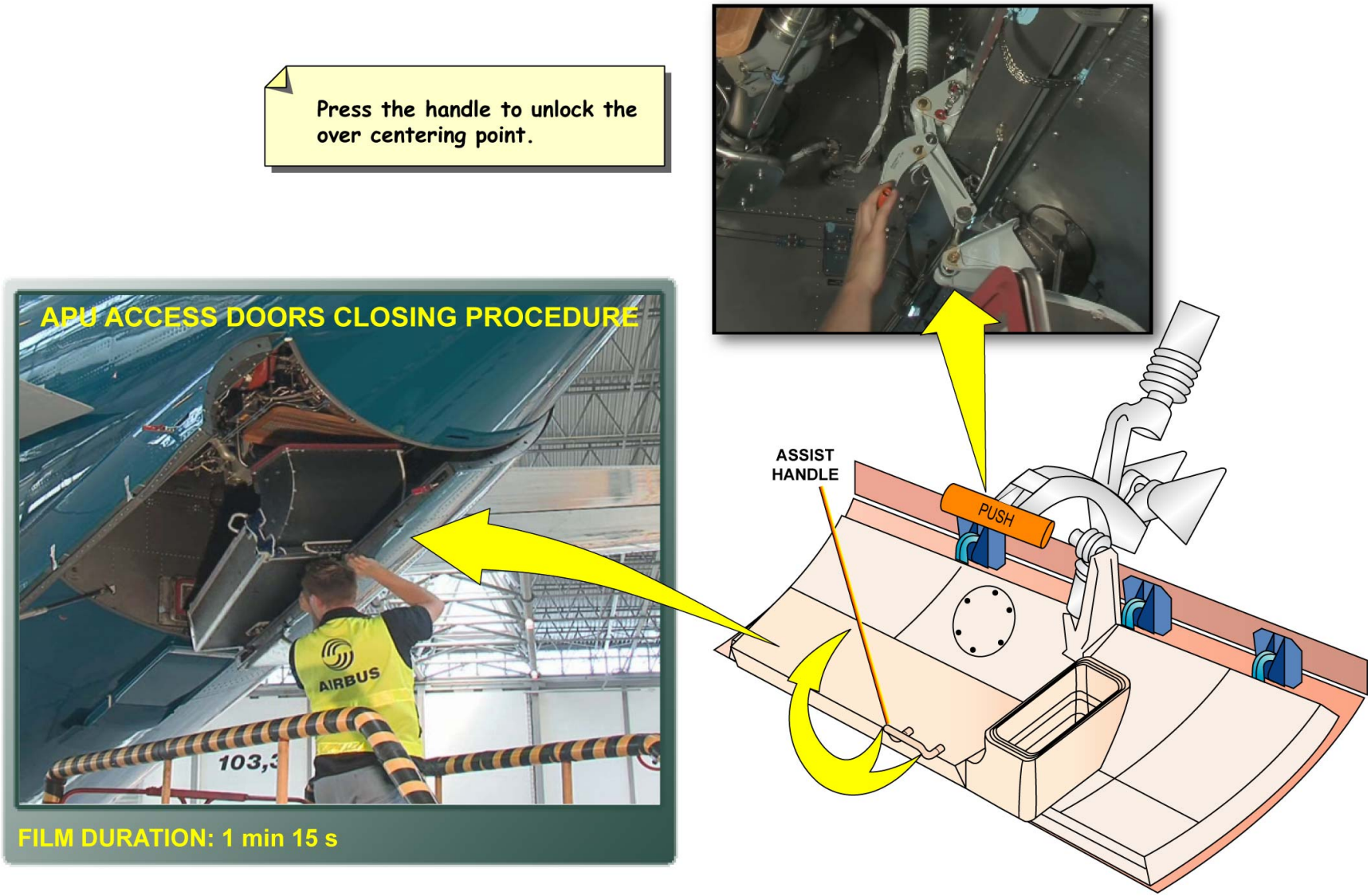
Press the handle to unlock the over centering point.
APU ACCESS DOORS CLOSING PROCEDURE
AIRBUS
FILM DURATION: 1 min 15 s
ASSIST HANDLE
PUSH

APU ACCESS DOORS CLOSING PROCEDURE

COMPT ACCESS DOORS OPENING & CLOSING (2)

DOOR REMOVAL PRECAUTION

CAUTION: In the event of door removal, you must secure the right access door hold-open device by inserting the locking pin in the locking hole. The pin is stowed next to this locking hole.

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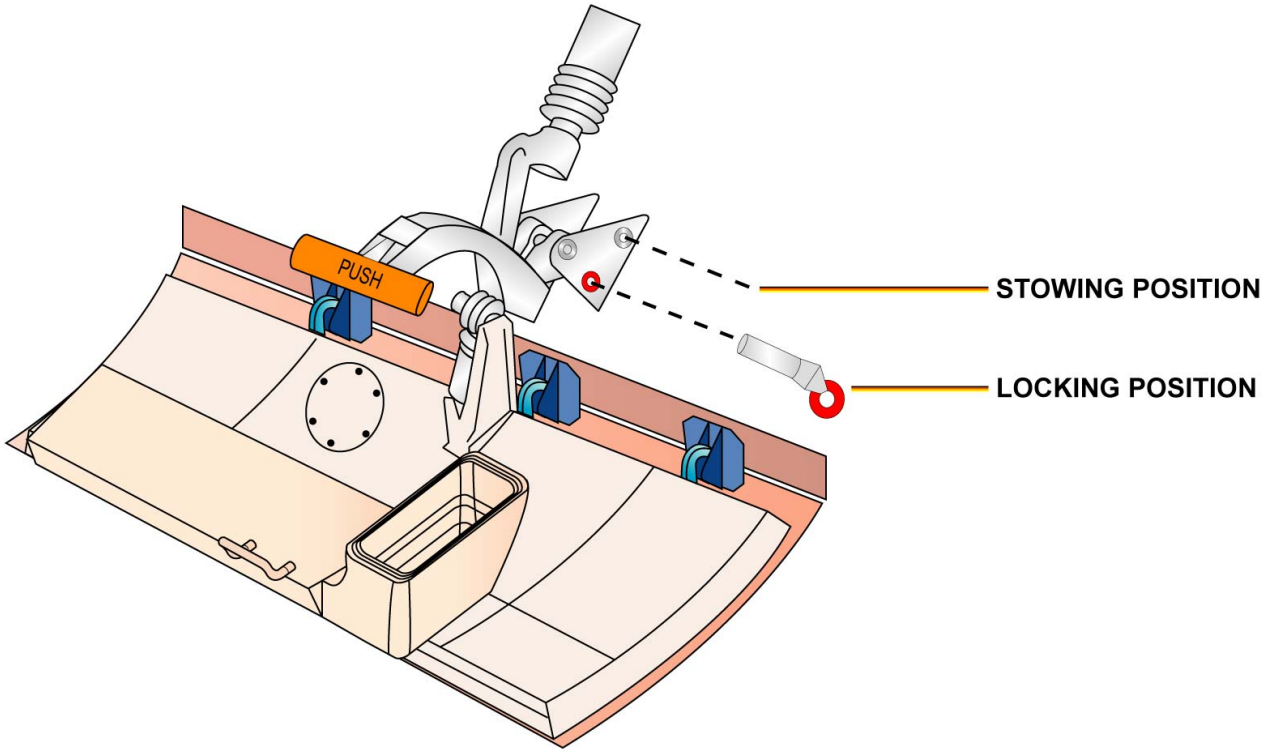

CAUTION

IN THE EVENT OF DOOR REMOVAL, YOU MUST SECURE THE RIGHT ACCESS DOOR HOLD-OPEN DEVICE BY INSERTING THE LOCKING PIN IN THE LOCKING HOLE.

THE PIN IS STOWED NEXT TO THIS LOCKING HOLE.

DOOR REMOVAL PRECAUTION

APU SYSTEM LINE MAINTENANCE (2)

SERVICING

APU OIL SERVICING

APU oil servicing is accomplished on an "as-needed" basis or after scheduled oil quantity checks. The oil indicating system shows if the oil quantity is sufficient or if an oil servicing is necessary.
The oil level information is displayed on the EIS and the Multipurpose Control & Display Units (MCDUs) in the cockpit on:
- the APU page on the lower ECAM display unit (LOW OIL LEVEL advisory),
- the APU SERVICE DATA page on the MCDU, indicating APU OIL Level O.K. or LOW.

NOTE: Note: The advisory appears on the ECAM APU page when the oil level has reached the ADD mark on the APU oil tank.

Airbus recommends servicing the APU oil at the next daily maintenance when the LOW OIL LEVEL message comes on. With no oil leakage, sufficient oil is available to allow a further 10 hours of APU operation.
Prior to servicing, shut down the APU and open the APU cowl doors.
Make sure to use the operator approved oil for servicing (operators may select from the approved list). The oil may be serviced by the gravity (most common) or pressure fill procedure (optional).
Gravity procedure:
- Open the lock and slowly loosen the oil filler cap to release remaining pressure from the oil reservoir,
- Check sight glass for level,
- Slowly add oil until the level is at the FULL mark on the sight glass.

Pressure fill procedure:
- Check sight glass for level,
- Connect pressure and overfill lines to APU gearbox,
- Slowly pump oil into the gearbox until the level is at the FULL mark on the sight glass.

Close and lock the oil filler cap.

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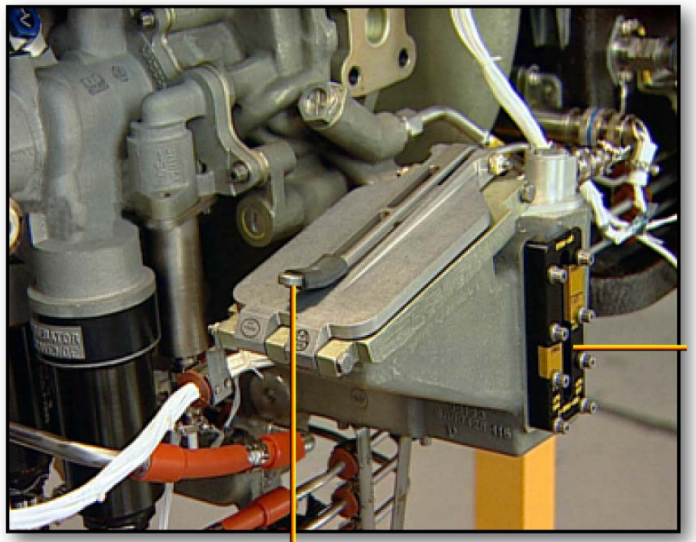
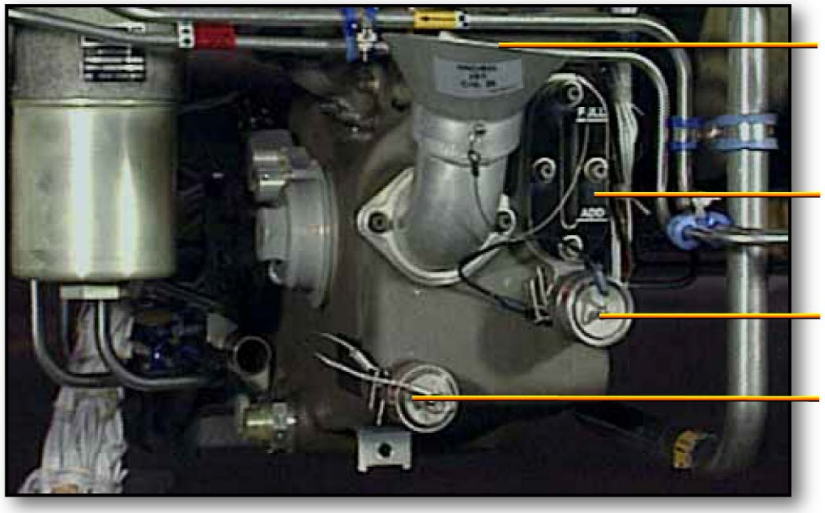
HONEYWELL 131-9A



AVOID FLUID SPILLAGE
USE APPROPRIATE STORAGE EQUIPMENT FOR CHEMICAL PRODUCTS

APS 3200



SERVICING - APU OIL SERVICING

APU SYSTEM LINE MAINTENANCE (2)

SERVICING (continued)

APU COWL DOOR OPENING & CLOSING

The APU cowl doors are secured with three quick-release fasteners and four shoot bolts. The quick-release fasteners secure the doors together and the shoot bolts secure the doors to the aircraft structure.
Procedure to open the doors:
- Release the quick-release fasteners,
- Hold the LH door and release the latches of the 2 shoot bolts,
- Open the door and secure it with the telescopic strut,
- Hold the RH door and release the latches of the 2 shoot bolts,
- Open the door and use the control handle to secure the door over center.

The doors are closed opposite from the opening sequence. The RH door is closed and secured first.

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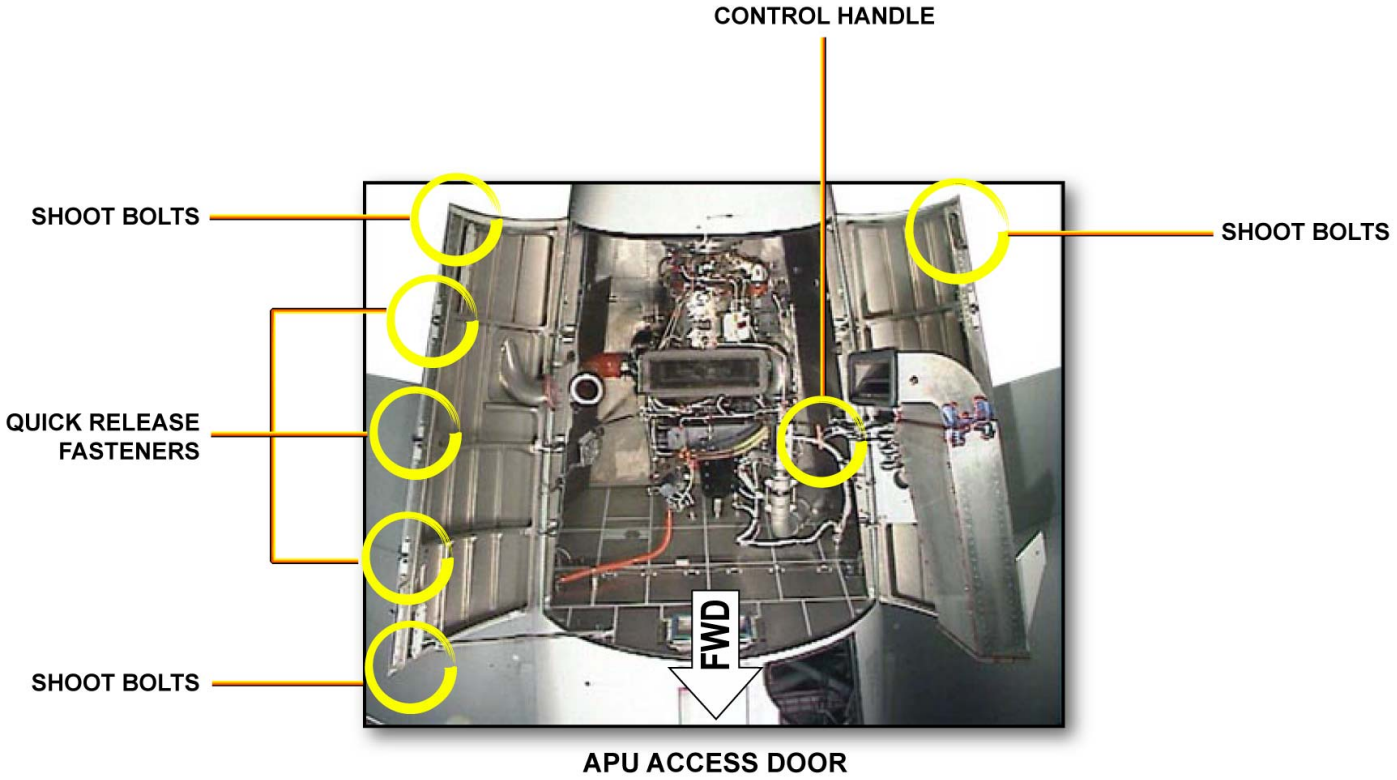

SERVICING - APU COWL DOOR OPENING & CLOSING

APU SYSTEM LINE MAINTENANCE (2)

MEL/DEACTIVATION

In case of an APU inlet actuator failure, the APU may be dispatched per MEL with the inlet OPEN or CLOSED. The APU will only be operational with the inlet deactivated OPEN (for a maximum of 10 days).
The air inlet actuator is equipped with a manual drive. In case of failure the manual drive may be used to move the inlet to the required position prior to deactivation. There are 2 different actuators that may be installed. One requires 47 turns of the manual drive for one full travel of the inlet. The other requires 87 turns. Access to the actuator is through an access door near the APU inlet on the right hand side of the fuselage.
Deactivation procedure:
- get access to the actuator,
- disconnect the actuator electrical connector from the fixed connector on the frame and install a blanking cap,
- use the manual drive to move the inlet to the required position. Use a torque wrench to avoid damaging the actuator.

If the inlet is deactivated CLOSED, no further action is needed other than to placard the APU inoperative. If the inlet is deactivated OPEN, the following procedure has to be accomplished.
When the inlet is in the OPEN position, a jumper lead needs to be installed to close the circuit and allow the APU to start. Make a dummy connector and paint it red for easy identification.

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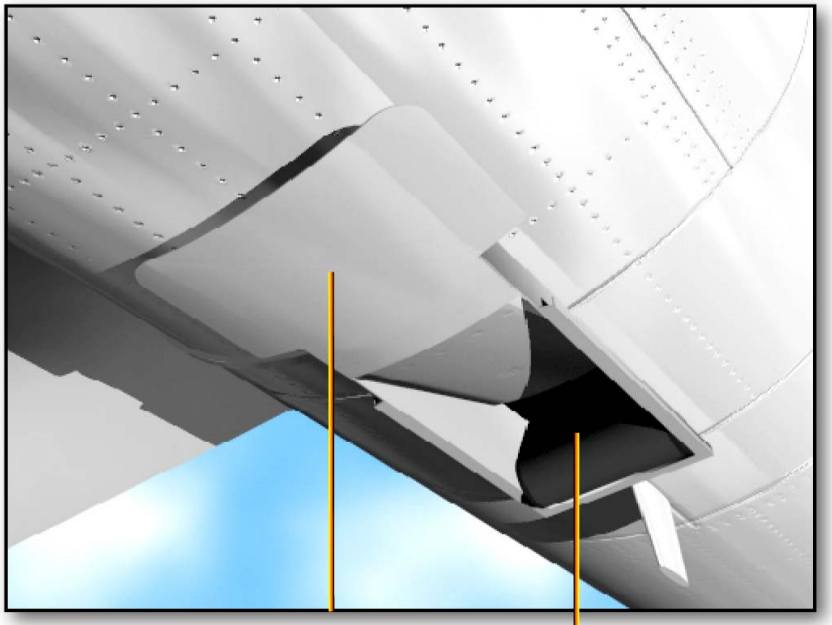
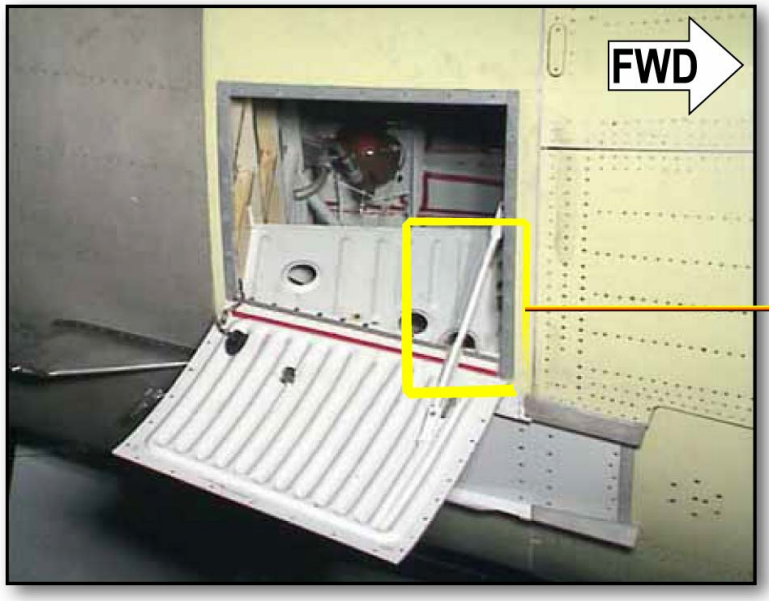
✓ Deactivation of the air intake flap

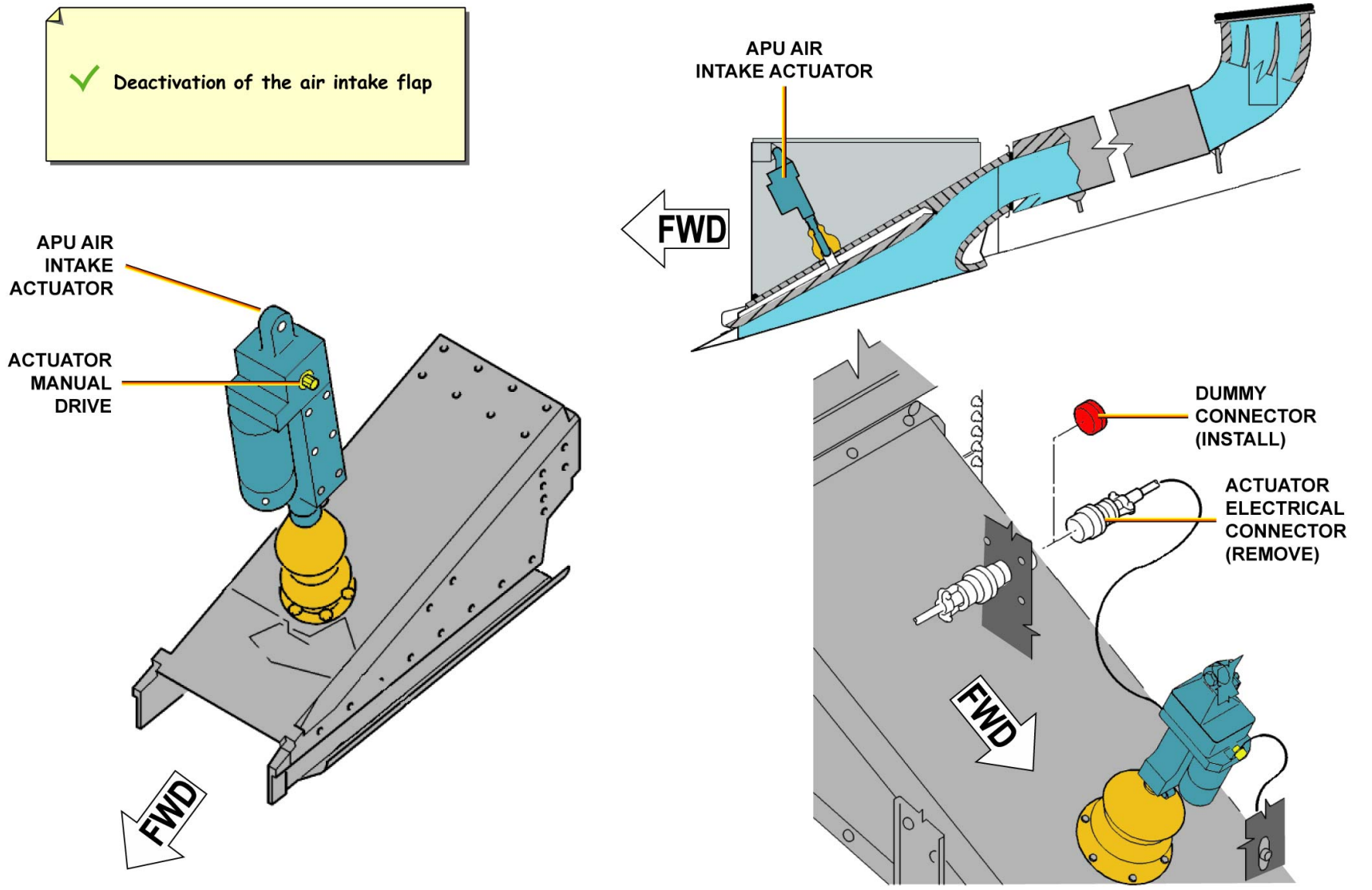


AIR INTAKE ACCESS DOOR FUSELAGE R/H SIDE



MEL/DEACTIVATION

✓ Deactivation of the air intake flap



MEL/DEACTIVATION

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APU SYSTEM LINE MAINTENANCE (2)

MAINTENANCE TIPS

The APU fuel supply line is equipped with a drain and vent valve which enables the line to be purged of air after maintenance. The drain valve is located in the APU compartment in the fuel supply line to the fuel control.
A switch labeled FUEL VENT PUSH is installed on the APU compartment forward firewall to allow maintenance to operate the APU fuel pump and purge the fuel line from the APU compartment. This switch allows the APU pump to operate and the APU Low Pressure fuel valve to open without the APU Master Switch ON.
A drain valve adapter tool is connected to the drain valve.
On the front firewall of the APU compartment:
- Push and hold the FUEL VENT pushbutton switch. At the APU fuel vent and drain valve, a continuous flow of fuel indicates that the APU fuel pump is operating and the line is purged,
- Release the FUEL VENT pushbutton switch. The flow of fuel stops when the APU fuel pump stops running,
- Disconnect the adapter tool.

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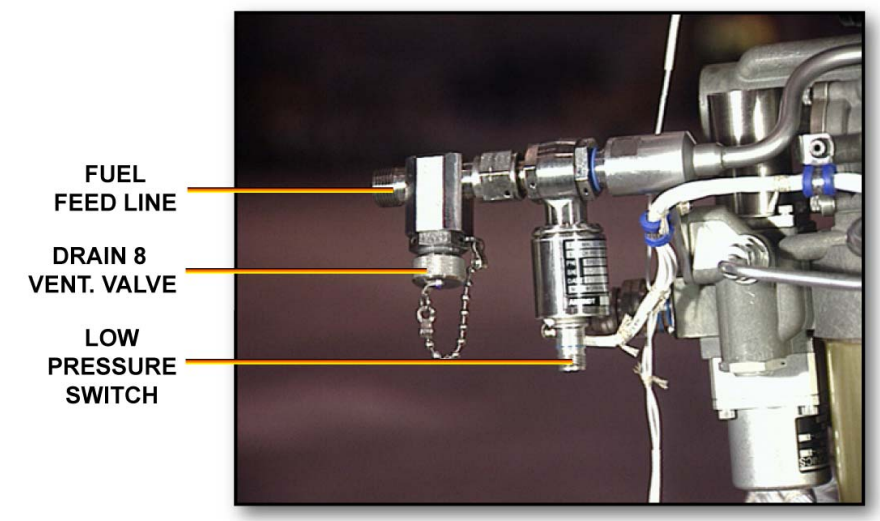
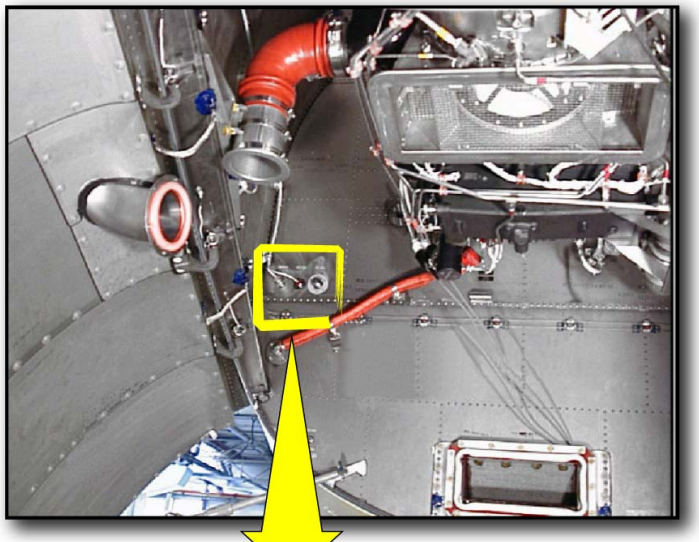
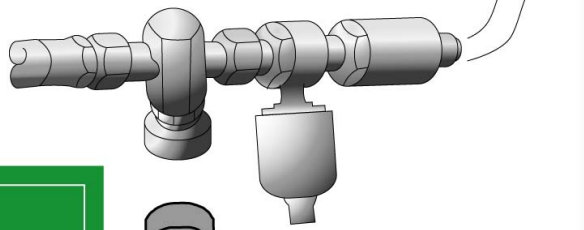
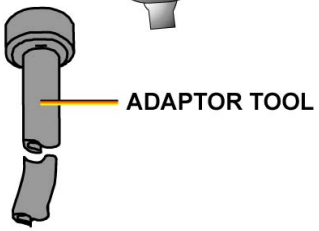
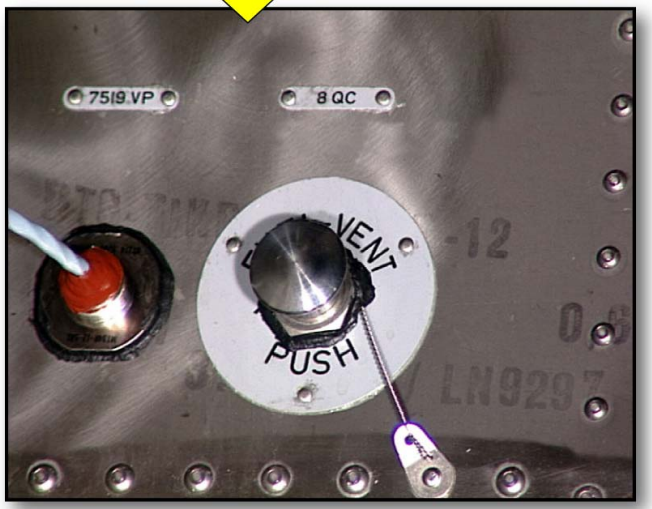


APU BLEED CONNECTION

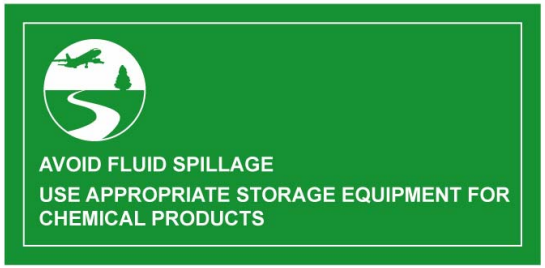








APU FUEL LINE P/B



MAINTENANCE TIPS

APU SYSTEM LINE MAINTENANCE (2)

MAINTENANCE TIPS (continued)

APU OPERATION WITH COWL DOORS OPEN

If it is necessary to operate the APU for maintenance with the cowls open, be sure to:
- Make sure the doors are secured in the Open position,
- Be aware of suction at inlet. Small items could be ingested,
- Make sure that proper fire-fighting equipment is available.

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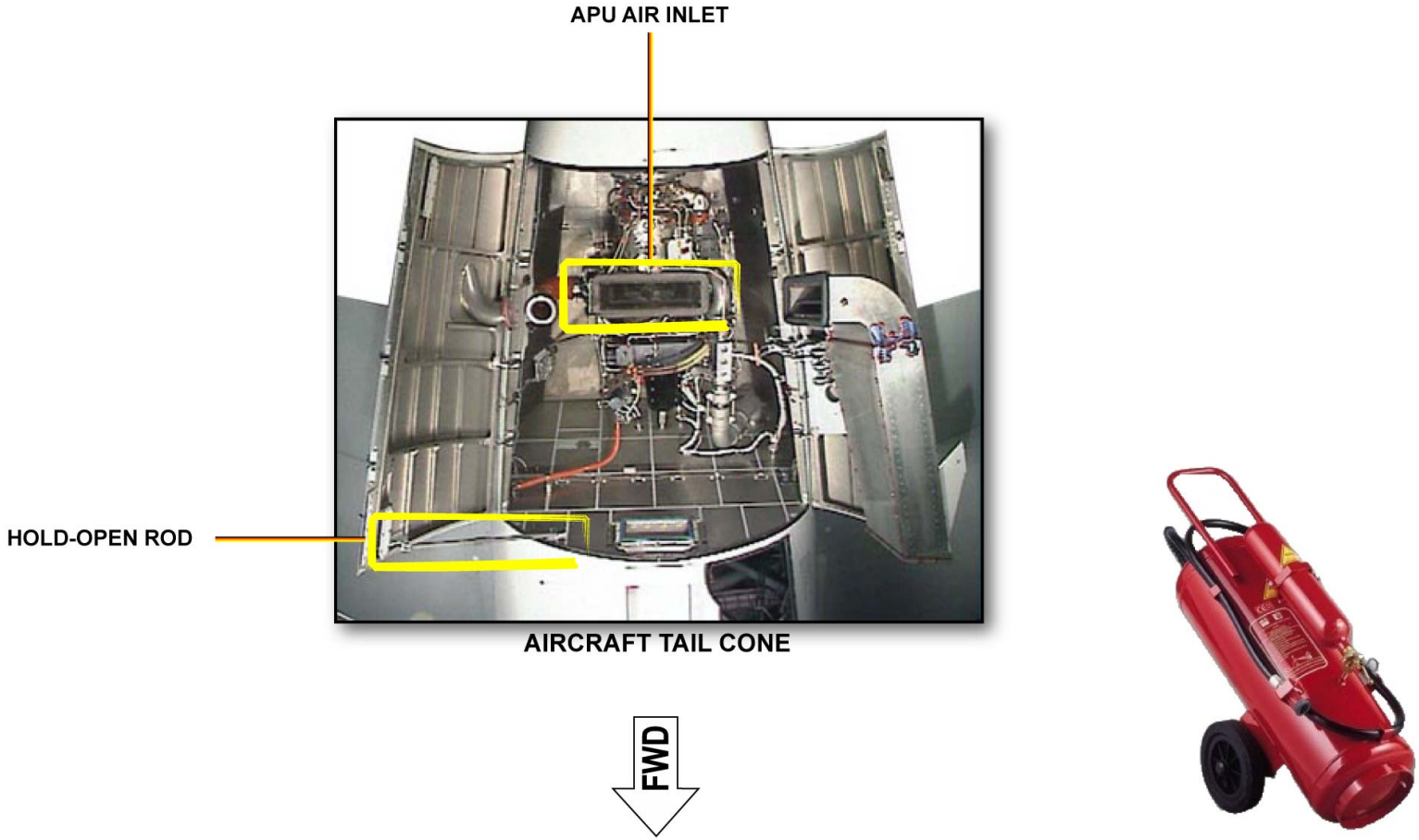

MAINTENANCE TIPS - APU OPERATION WITH COWL DOORS OPEN

APU SYSTEM LINE MAINTENANCE (2)

ENVIRONMENTAL PRECAUTIONS

Do not discharge products such as oil, fuel, solvent, lubricant either in trash bins, soil or into the water network (drains, gutters, rain water, waste water, etc...).
Sort waste fluids and use specific waste disposal containers.
Each product must be stored in an appropriate and specific cabinet or room such as a fire-resistant and sealed cupboard.
Avoid use of the APU if APU BLEED air is not necessary. Turn-off unused ground service equipment (GPU, Air conditioning cart, etc...) if no work is being done or nobody is present on the aircraft.

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STORE PRODUCTS IN APPROPRIATE CONTAINER/CUPBOARD/ROOM

SORT WASTE FLUIDS IN CONTAINERS

AVOID FLUID SPILLAGE
USE APPROPRIATE STORAGE EQUIPMENT FOR CHEMICAL PRODUCTS
LIMIT AIR POLLUTION (EXHAUST SMOKE, GAS EMISSIONS...)

FLUID SPILL CLEANUP KIT

USE SPECIFIC WASTE DISPOSAL CONTAINERS

ENVIRONMENTAL PRECAUTIONS

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